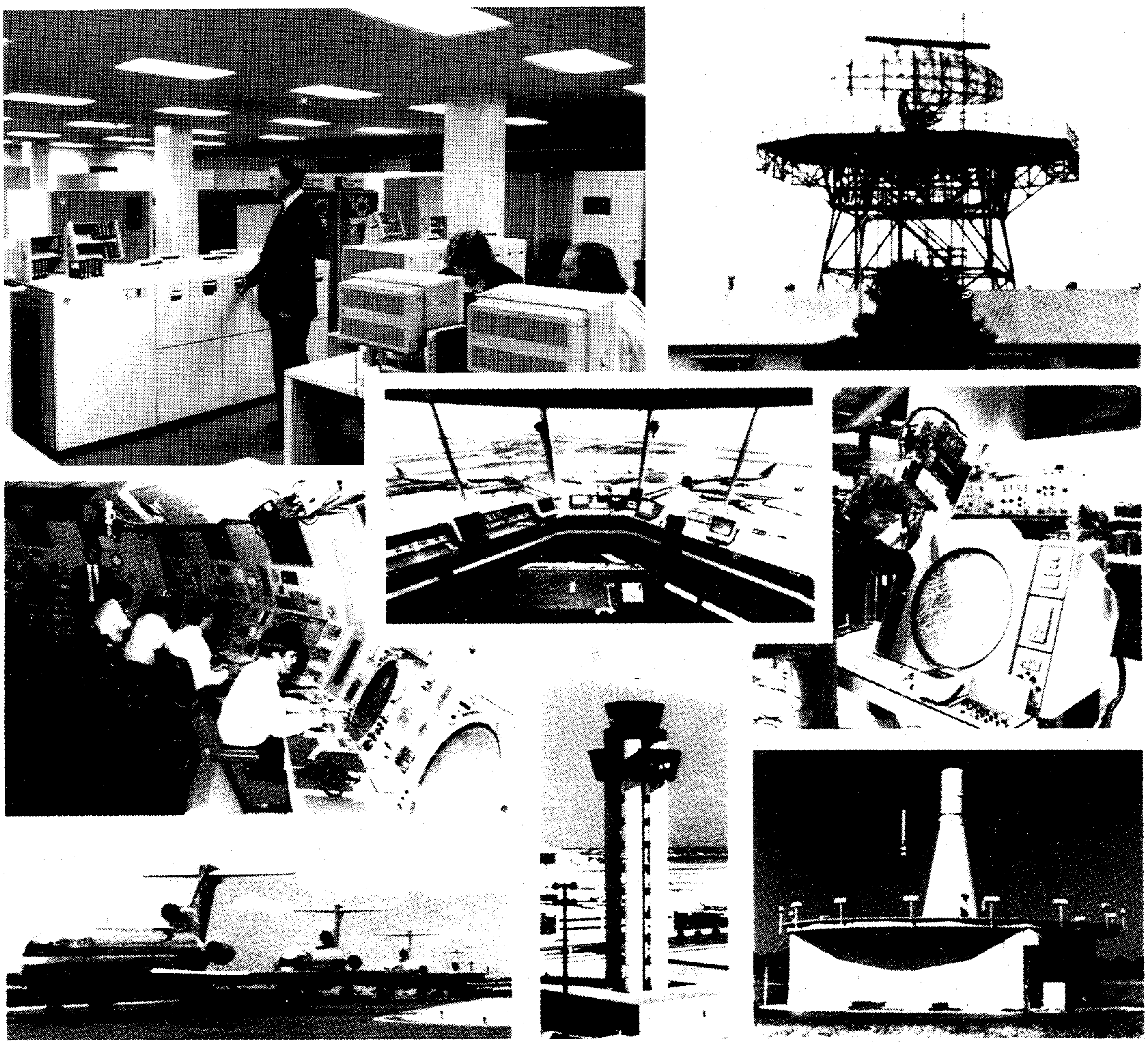
U.S. Department
of Transportation
Federal Aviation Administration

National Airspace System Plan

Facilities, Equipment, Associated Development and Other Capital Needs



September 1989

**Congressionally Requested Update
Pursuant to Sec 504(b)(1) P.L.97-248**

U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

For the past decade, the Federal Aviation Administration (FAA) has undertaken the task of implementing a capital investment plan that addresses the ever-changing demands of the aviation industry. This eighth edition of the National Airspace System (NAS) Plan reflects the major accomplishment of the FAA as it shifts from system design and acquisition to system implementation. Despite these major accomplishments more will be required to meet the challenges that are continuing to face the aviation community today. The current capital investment outlook has grown to include many initiatives, such as the expansion of some of our major airports and the addition of a new one.

In order to refocus and present the FAA's plan for future requirements and modernization of the NAS, this will be the last year of the NAS Plan in its current form. New initiatives to meet the changing demands of the user community are the impetus for the new 1990 capital investment plan.

The new plan will incorporate changes in approach, format, and thrust. Development of a new plan will be a major undertaking. However, it is my objective to have it published by mid-1990.

Our goal is for a continued safe and efficient National Airspace System as it transitions into the 21st century.

J.B. Busey

James B. Busey
Administrator

CHAPTER I

EXECUTIVE SUMMARY AND OVERVIEW

over the next two decades. Continuing growth in the number of aircraft operations, number of aircraft, enplanements, diversity of operations, DOD operations and sophistication of aircraft will place unprecedented demands on the NAS. Meeting this challenge requires improved and expanded services, additional facilities and equipment, improved work force productivity, and the orderly replacement of aging equipment.

In December, 1981, the Federal Aviation Administration (FAA) chartered a comprehensive NAS Plan for modernizing and improving air traffic control and airway facilities services through the year 2000.

This is the the seventh annual update of the NAS Plan. The Plan addresses the compelling problems of how best to improve safety and efficiency, accommodate spiraling demands for aviation services, deal with the problems of aging or obsolete facilities, recognize the users desires for minimal restrictions on the use of the airspace, allow for a reduced Federal role, and create a foundation for continued evolution which exploits newer technologies and developments obtained through continuing research. The recurring theme throughout the Plan is that the solution lies in greater use of automation, consolidations of major facilities, and application of cost effective technological solutions.

The FAA has made substantial progress in implementing the Plan. Projects which replace obsolete equipment are complete or well underway. Growth at many locations has been accommodated by the deployment of added capabilities. Real productivity gains have been achieved.

However, increases in system capacity demands created by deregulation, further development of the centralized hub principle by several airlines, and NAS Plan schedule changes have resulted in the need to reexamine the operational, technical, and

zation that the NAS Plan does not describe an activity which will be completed in a specific time period. The Plan is evolving into a document which identifies activities envisioned for the future and which can be expected to be modified as progress, time and technology sharpen our understanding of future needs. New to the Plan is a chapter recognizing the significant role DOD plays in air traffic control as both a user and a provider. Projects have been added to this year's plan to meet growing operational needs in the Chicago area, to increase capacity at locations with closely spaced parallel/converging runways, to improve logistics, and to upgrade communications and surveillance performance.

On the horizon are those longer term evolutionary changes which will dramatically improve the air traffic control and air navigation system in terms of safety, capacity, and economy. The specific improvements, required long term capabilities, and the planned system evolution essential to flight safety and economy are evolving in a measured but well-ordered and rational manner. Benefits to the taxpayers and users of the NAS are substantial and achievable.

Anticipated long range advances in computer, communication, and satellite services currently in research and development may facilitate new and more automated control concepts, remove fixed-routing constraints, and provide high levels of civil aviation system safety, reliability, and capability for future aircraft types such as tiltrotor, supersonic, or hypersonic. New satellite communication and navigation facilities will support more flexibility in en route navigation and permit satellite transmission of voice/data communications. They will also provide suitably equipped aircraft with supplemental or sole means of navigation for nonprecision approach guidance in oceanic or remote areas where it is not currently available.

system has compiled, and continues to compile, an outstanding record of operational safety and efficiency. Prior to the 1980's, improvements in technology or innovations in procedures were implemented in a manner that principally remedied localized operational problems that already had or were expected to occur. System evolution involved a series of piecemeal adjustments and improvements. This evolution produced a mixture of equipment of varying technological generations and types. As a result, the system of 1980 was expensive to operate and maintain, expansion capability was limited, and adaptability to changing requirements was difficult.

What had been missing was a plan for evolution designed to implement National Airspace System improvements which met stated goals and objectives. The National Airspace System Plan for Facilities, Equipment and Associated Development, first issued in 1981 and revised annually per congressional request, satisfied the need to define the orderly and rational evolution of the system as a whole.

Since 1981 substantial progress has been achieved in executing these new directions. The contents of this year's Plan reflect these achievements and FAA's best judgments on future actions still required to modernize the National Airspace System in accordance with previous Plans. Additionally, this document contains plans for other capital needs which have previously been unforeseen.

of aging or obsolete facilities, recognize the user's desires for minimal restrictions on the use of the airspace, allow for a reduced Federal role, and create a foundation for continued evolution which exploits newer technologies and developments obtained through future research).

The Plan provides near-term improvements to solve immediate problems, but, equally important, these improvements are taking place as part of an orderly, planned evolution. On the horizon is a modern, automated network of facilities and equipment in which the latest levels of available technology are integrated into a coordinated system for air traffic control and air navigation. The results will be the replacement of outdated tube-type electronic equipment with solid-state devices and the addition of more equipment to meet current and future needs for existing services. NAS modernization will assure safe and efficient transportation for all who use and depend upon the National Airspace System and provide the foundation for sustained improvement.

Planning and system design fully recognize the presence of the large number of military air traffic control facilities that provide services within the NAS to civil and military aircraft alike. Modernization efforts recognize the continued need for these military facilities and the need for efficient interaction with those of the FAA. Planning also recognizes the need for the NAS to provide a number of unique services to military aircraft and the necessity of the NAS to be responsive to national defense requirements.

the level at which it will proceed.

GOALS

The central objective of this Plan is to provide for the safe and efficient use of the Nation's airspace, while minimizing constraints on its use. Specific objectives include:

- Having an operating National Airspace System in place that meets the national aviation demand at the time it is required.
- Accommodating increasing demand in a way that allows airspace users to operate with a minimum of artificial constraints and with fuel efficiency.
- Reducing operational errors by 80 percent between 1984 and 1995. Techniques for more accurate classification and counting have been developed.
- Reducing risks of midair and surface traffic collisions, landing and weather-related accidents, and collisions with the ground.
- Increasing air traffic controller and flight specialist productivity by a factor of at least two by the year 2000, compared with 1980. The productivity goal in the year 2000 is 10,982 operations per position per year.
- Reducing the technical staff required to maintain and operate the modernized and expanded system by one-third by the year 2000, compared with 1980. By the year 2000 the technical staff is expected to be 7,735.

premises were considered to be logical and valid assumptions. Some of these assumptions have not occurred as expected. Examples of these assumptions are:

- Aviation demand will grow significantly during the next 20 years.
- Air carrier routes and services will reflect a better balance between trip frequency and cost than would be the case under a closely regulated system.
- The commuter airline industry will be affected by deregulation for several more years. Anticipated growth will require many years of adjustment before routes and schedules stabilize. The number of commuter operators is expected to decrease slightly over the period.
- Growth in business use of IFR equipped general aviation will continue. Significant growth in turbopowered aircraft will result in increased operations above 12,500 feet. This growth is expected even though both fixed and variable costs of operating aircraft are increasing.
- The number of general aviation aircraft will increase.
- System limitations on any class of users' right-of-access to the system should be imposed only when no other recourse is available to ensure the common good. Any such restrictions should be removed as soon as possible and not be considered a final solution. However, to gain access to the system, individual users must comply with conditions applicable to all classes of users and essential to the safety and efficiency of the system.

called traffic alert and collision avoidance system (TCAS), will be available. "See-and-be-seen" operations will continue.

- Most major airports have limited expansion capability due to physical, environmental, airspace, runway, and/or landside limitations. Few new large commercial service airports are anticipated. These factors will continue to impose capacity constraints at many large and medium hub airports.

- A limited amount of additional capacity will be achieved primarily through reduction in separation standards resulting from technological has had positive impact on the airspace structure, and follow-on activity is, therefore, likely to affect this Plan.

- Fuel will be available. The only fuel constraint used in developing the demand forecast in this Plan is that of price.

- ATC services within the NAS will continue to be provided by a mix of civil (FAA) and military air traffic control facilities. The military approach controls, control towers, and other facilities will provide service to civilian and military aircraft alike.

reflecting senior management policy discussions, goals, and objectives.

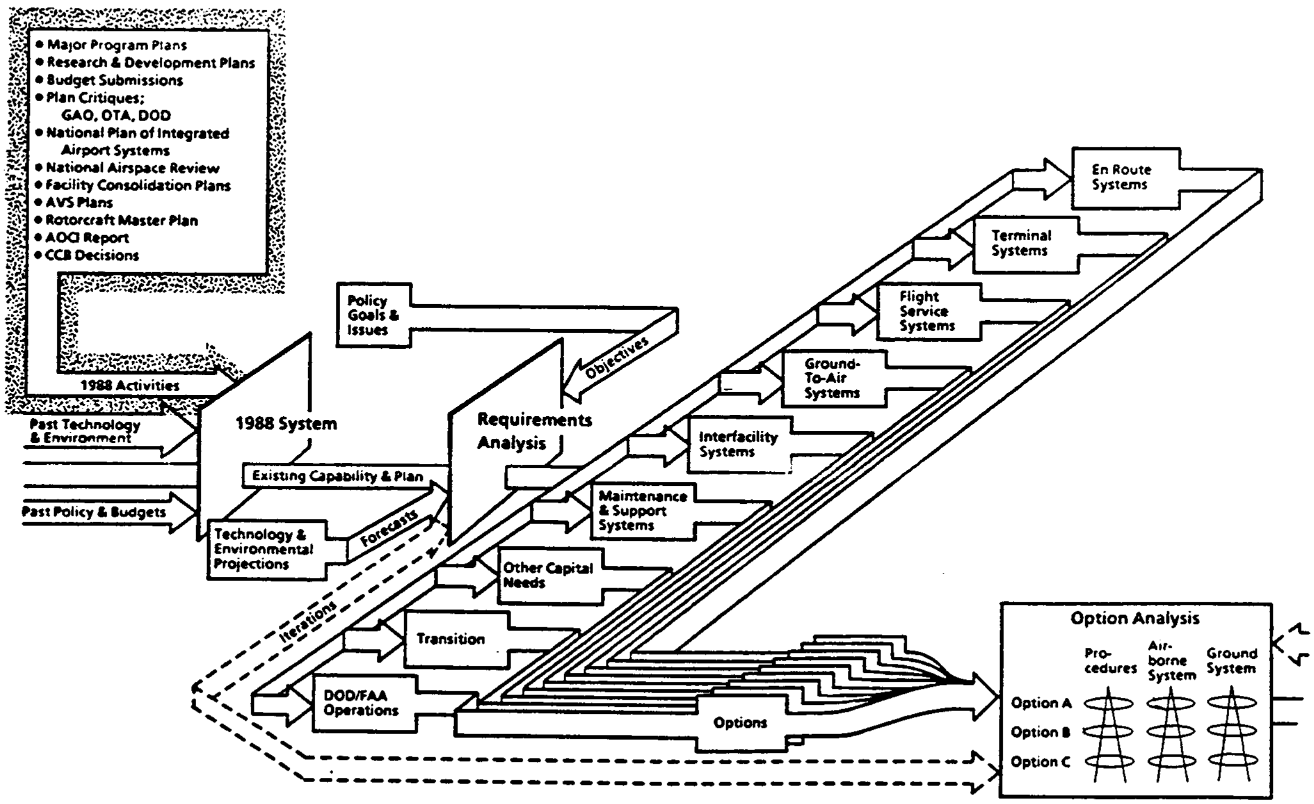
Necessary changes are developed in a structured change control process where they are reviewed by knowledgeable evaluators for technical, cost, and schedule impacts. All recommended changes are ultimately decided by the NAS Configuration Control Board. Approved changes are then added to the Plan.

The update process also includes a review of current services, system capabilities, equipment, and plans along with projections of required services, future technology, and forecasts of traffic demand and mix.

consistent within each system element and between system elements, and, most important, compatible with the agency's goals. This process is depicted in the following illustrations.

Consideration is given to the necessary expansion of the system to meet anticipated future demands, provide improved safety and services, reduce operating costs, and modernize and replace aging facilities and equipment through the year 2000.

The revised Plan reflects revisions to the status of each project and incorporates the results of further planning, studies, and decisions that were made in the past year.

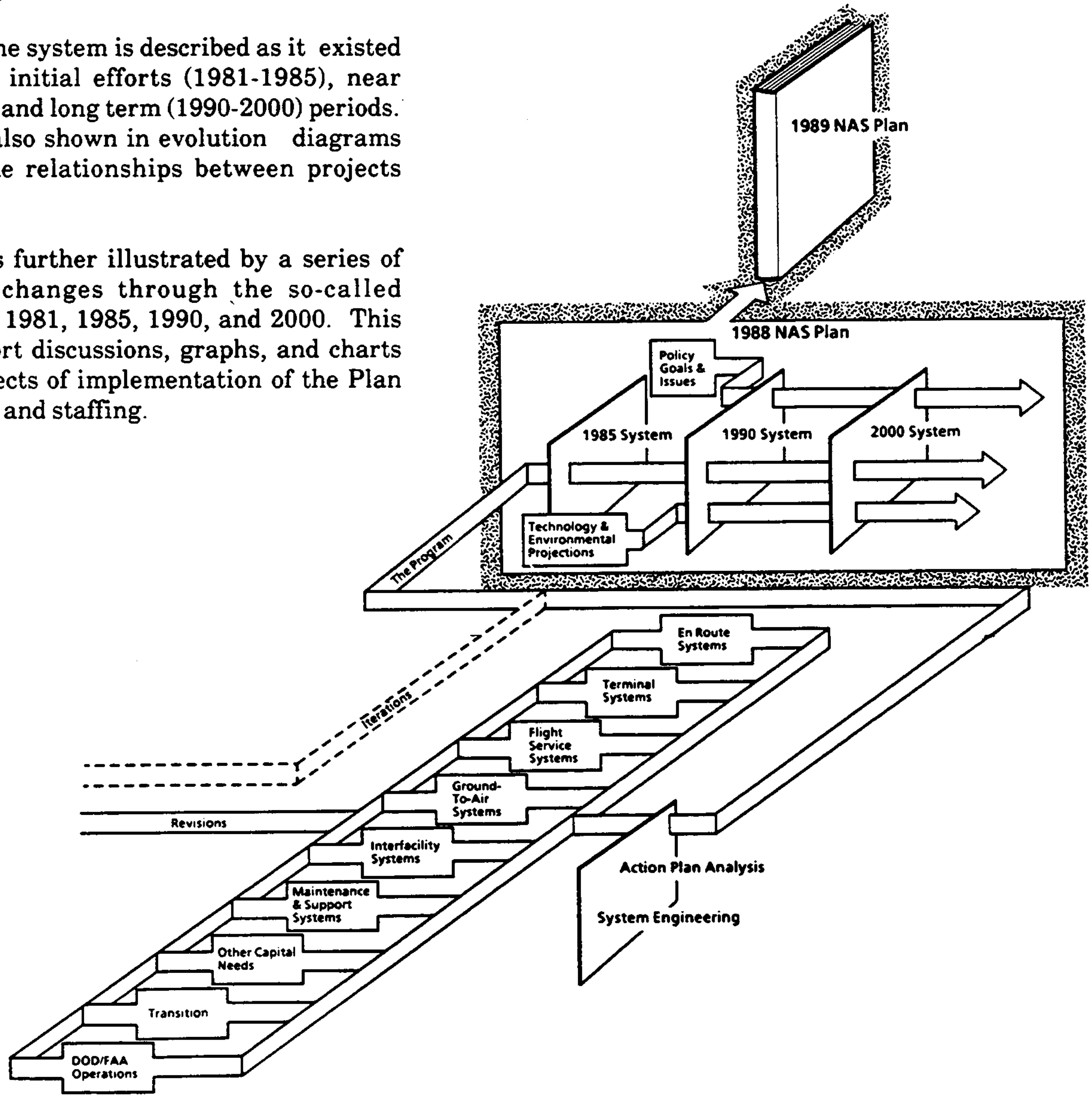


describes the system activities that support the transition and evolution from today's NAS into the end state systems described in Chapters III through VII of the Plan. Chapter IX contains a brief summary of the Department of Defense (DOD) interaction with the NAS. Each section pertaining to a major element of the NAS contains a narrative description of the system as it existed prior to implementation of any of the NAS Plan projects.

The evolution of the system is described as it existed at the end of the initial efforts (1981-1985), near term (1985-1990), and long term (1990-2000) periods. The evolution is also shown in evolution diagrams which indicate the relationships between projects and systems.

The description is further illustrated by a series of maps depicting changes through the so-called "snapshot" years: 1981, 1985, 1990, and 2000. This is followed by short discussions, graphs, and charts indicating the effects of implementation of the Plan on operating costs and staffing.

project. Some projects may be F&E acquisitions of existing technology or off-the-shelf systems that do not require R&D efforts. Others may require R&D efforts for the development of systems or software.



support contract in February 1984. Under the contract, the SEI contractor shares with FAA the mission responsibility for implementing the NAS Plan within budget and on schedule. The SEI contractor is providing program management support to the NAS Program Director, system engineering support for the design, integration, and transition planning, and in-depth technical assistance to the individual managers of the NAS Plan projects.

Successful completion of the NAS Plan projects requires intensive management attention and the application of disciplined system engineering and management principles. The FAA and SEI contractor have established the organization, procedures, and processes to monitor and control the technical and financial aspects of the total NAS program. These controls include cost, schedule, risk analysis, benefits analysis, and configuration management accomplished through the use of supporting automated systems.

A master schedule system has been established. The schedule status of projects, reflected in this edition of the NAS Plan, is derived from this system.

Due to the size and complexity of the NAS modernization program, the system engineering tasks have been divided into three principal elements: functional design, allocated design, and the transition plan. The functional design was completed and baselined in October 1984. This baseline document defines the NAS architecture and provides a functional description of facilities and their interdependencies. The design allocates functions to subsystems based on operational requirements.

issues requiring resolution, added capability, and an overview for the affected facilities during several iterative configurations. A draft plan has been released, and the plan will be updated annually.

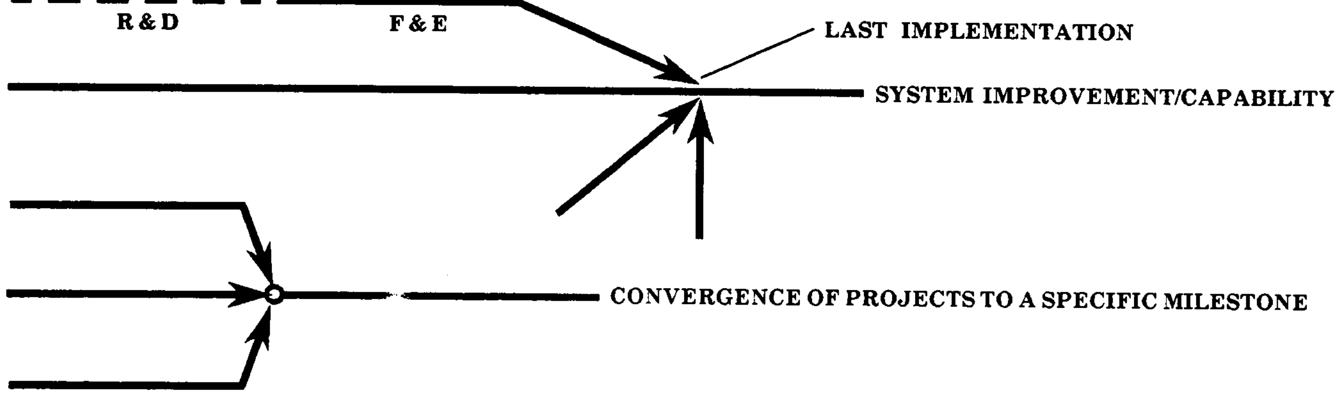
A result of the transition planning was the development of accelerated enhancements required to meet current capability and reliability concerns in the operational NAS. These enhancements, which are contained in Chapter VIII, include several initiatives to support current NAS operational, technical, and personnel requirements. A significant initiative supports the development of a Human Resource Management Plan which will provide the basis for managing the expected staffing, training, and relocations required to implement the NAS Plan.

In conjunction with the system level design and transition planning, an integration test plan has been developed to define the system integration tasks that should be performed at the FAA Technical Center. The plan defines test configurations for laboratory resources to verify that the performance requirements have been met before systems are implemented in the field.

Extensive project-level technical support is also being provided by the SEI contractor. This includes independent verification and validation of software, technical assistance in subsystem specification development, and monitoring of individual development contracts. SEI contractor resources have been established at all regional offices, all ARTCCs, the FAA Technical Center, and the Aeronautical Center.

skills, training programs, support equipment, maintenance facilities, transportation, handling, packaging, and other support requirements. Implementation of NAILS is governed by the NAILS Master Plan which provides specific requirements, describes tasks, and identifies responsibilities.

prior to field deployment. To date we have completed the review for 16 projects of which the more notable are the ASR-9, PAPI, D-BRITE, ATIS, HIWAS, and ARTS IIA



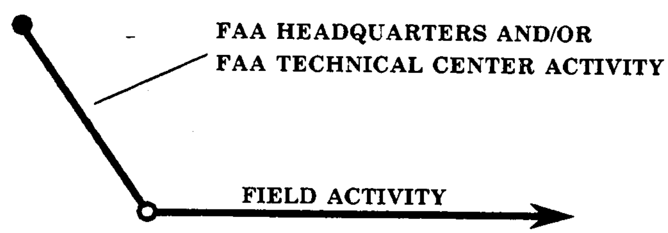
Project Schedules: Chapters III through VIII include schedule diagrams for each specific project. These diagrams include R&D and F&E activities where appropriate. The following legend provides a guide for the reader's use when reviewing project schedules.

LEGEND:

● COMPLETED MILESTONE

○ PROJECTED MILESTONE

➔ ESTIMATED MILESTONE BEYOND CY 2000



controller work stations (i.e., sector suites) will increase capacity and availability.

- Higher levels of automation will improve safety, fuel efficiency, and productivity.

En route and terminal radar approach control facilities will be consolidated into area control facilities (ACF) with most hardware and software elements identical. The central computers will be of the same family, and sector suites used will be identical.

Within each ACF, the advanced automation system (AAS) will have computer processing capability distributed between common processing equipment and the individual sector suites. Sector suites will provide a new environment in which air traffic controllers function more effectively. In a typical sector suite, multiple displays will provide a plan view of the air traffic and weather situation; alphanumeric flight and weather data and other aeronautical information, such as notices to airmen; and traffic planning data including the ability to probe the system for conflict-free, fuel-efficient flight paths. Sector suite processing capability and the designed reduced capability and emergency modes of the AAS will ensure that required surveillance, flight data, and weather information are available at the particular controller position.

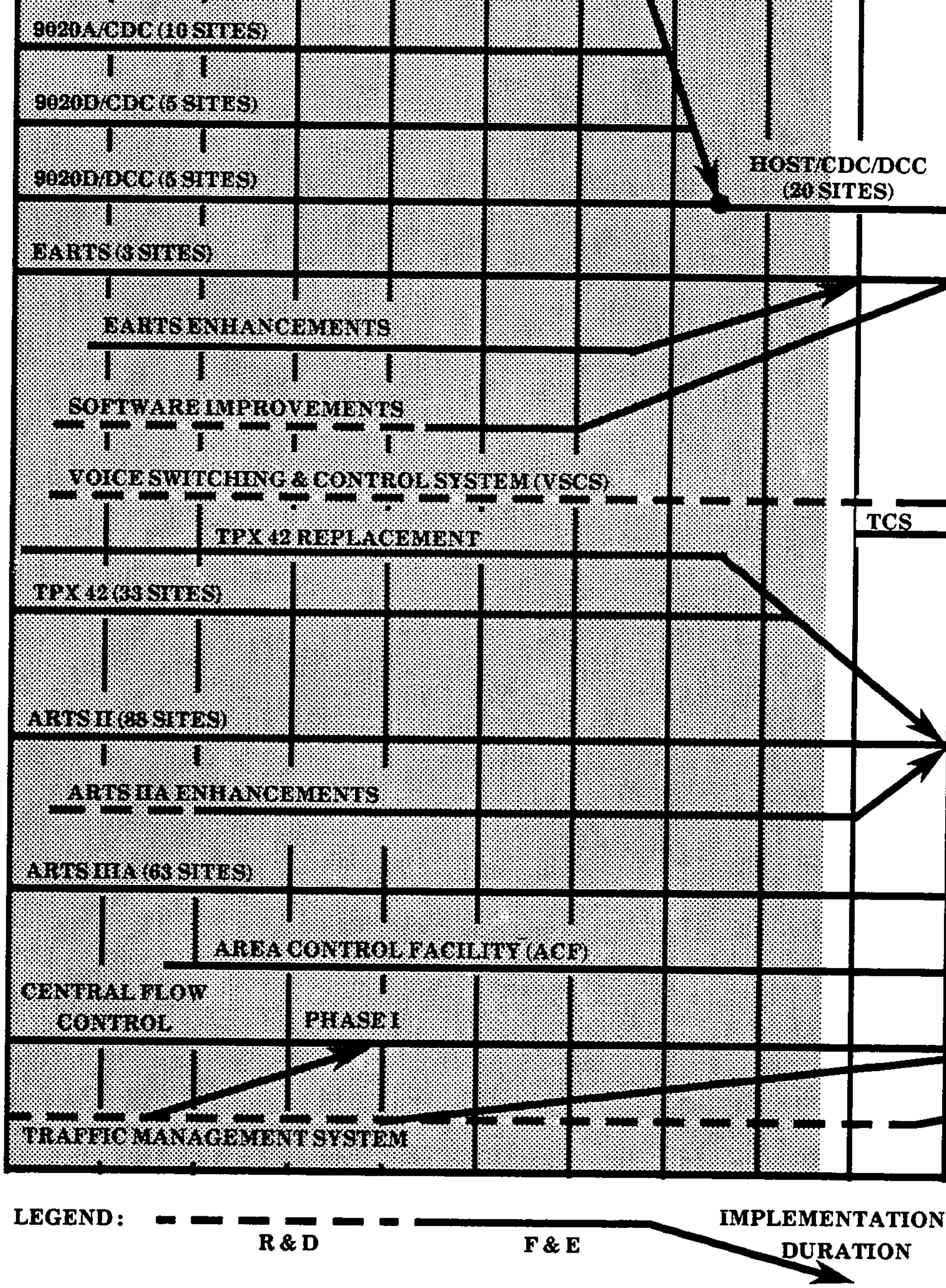
The advanced functions of automated en route air traffic control (AERA) will be added in incremental steps. Direct fuel-efficient route planning, flow planning, and traffic management will be added before strategic planning and full tactical clearance generation. During the period of the Plan, computer-generated clearance messages, weather, and flight information will be transmitted directly to aircraft via data link.

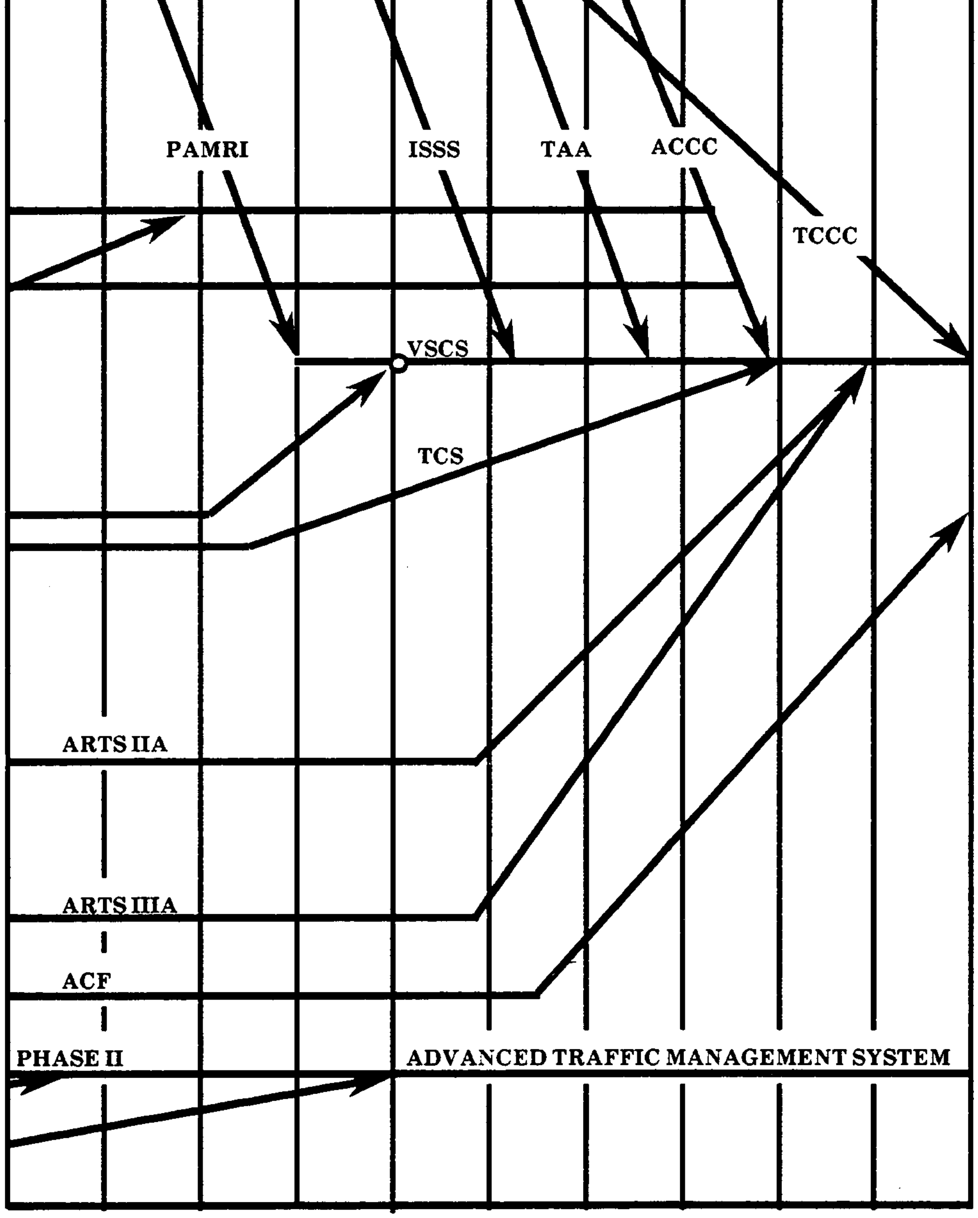
CONSOLIDATION AND STANDARDIZATION

Substantial productivity gains and reduced costs will be realized through consolidation. By the year 2000, en route and terminal radar approach control functions will be consolidated into area control facilities. The consolidation will transform all en route centers and 188 terminal radar approach control facilities into less than 30 major air traffic control facilities. Supporting airport traffic control towers will remain in place and will be supported by advanced processing and display capabilities.

System standardization will establish a family of FAA automation, display, and communication systems that provide a wide range of benefits and cost reductions. System standardization reduces lifecycle costs due to common operations and maintenance techniques, common engineering and staff support, lower investment in development and procurement, and common logistics and training support.

- AERA 3 functional concept document completed.
- VSCS prototype system contracts awarded.
- En Route Automation Hardware Improvements Project completed.
- Integration of nonradar approach control into radar facilities completed.
- CA/MCI operational at all 20 facilities.
- DARC enhancement mosaic software operational in 16 of the 20 CONUS ARTCCs.
- Conflict Resolution Advisory contract awarded for en route facilities.
- OFDPS contract awarded.
- TMS system specification approved.
- ARTS IIIA Assembler completed.
- ODAPS equipment delivered and being tested at New York ARTCC and Oakland ARTCC.
- ARTS II displays installed.
- Additional ARTS IIIA memory implementation completed.
- Enhanced Terminal Conflict Alert implementation nearly completed.
- Additional ARTS IIIA support at the FAA Technical Center completed.
- ARTS II Interfacility Interface with ARTCCs completed.
- ARTS II Interface with MODE S/ASR 9 production and factory tests completed.
- 10/20 Channel Recorder implementation begun.
- ETG displays installed at ARTS III locations.
- ATIS Recorder implementation completed.


9020A/CDC (10 SITES)
9020D/CDC (5 SITES)
9020D/DCC (5 SITES)
HOST/CDC/DCC (20 SITES)
EARTS (3 SITES)
EARTS ENHANCEMENTS
SOFTWARE IMPROVEMENTS
VOICE SWITCHING & CONTROL SYSTEM (VSCS)
TCS
TPX 42 REPLACEMENT
TPX 42 (33 SITES)
ARTS II (88 SITES)
ARTS IIA ENHANCEMENTS
ARTS IIIA (63 SITES)
AREA CONTROL FACILITY (ACF)
CENTRAL FLOW CONTROL
PHASE I
TRAFFIC MANAGEMENT SYSTEM
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



EN ROUTE AND TERMINAL ATC SYSTEMS EVOLUTION

stop" service for weather, flight plan filing, and information about system status (delays, outages, etc.).

- Greatly improved aviation weather services will increase safety and be tailored to meet individual needs.

By the year 2000 the system will have the capability to provide the majority of flight services directly to pilots without specialist intervention. The system will also provide weather data base access to specialists on an interactive basis.

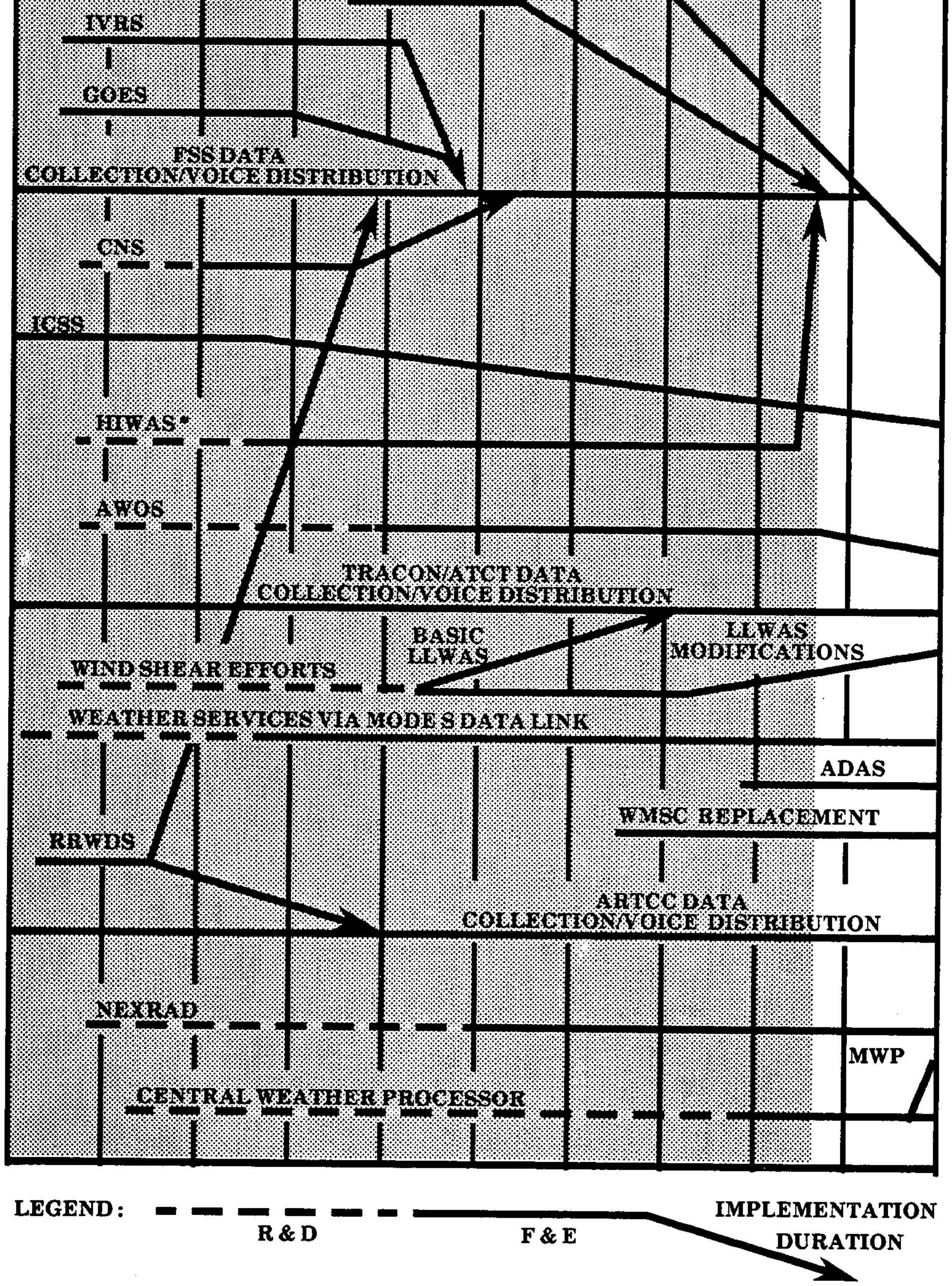
An enhanced weather position operated by a meteorologist will be located in each area control facility. Aviation weather collection, processing, and dissemination will be improved. The intent is to provide current aviation weather information throughout the National Airspace System for pilots, center and tower controllers, flight service specialists, and traffic management personnel.

Automatically composed, routine en route and terminal weather will be broadcast to pilots over a national VOR network with coverage down to 2,000 feet above the terrain.

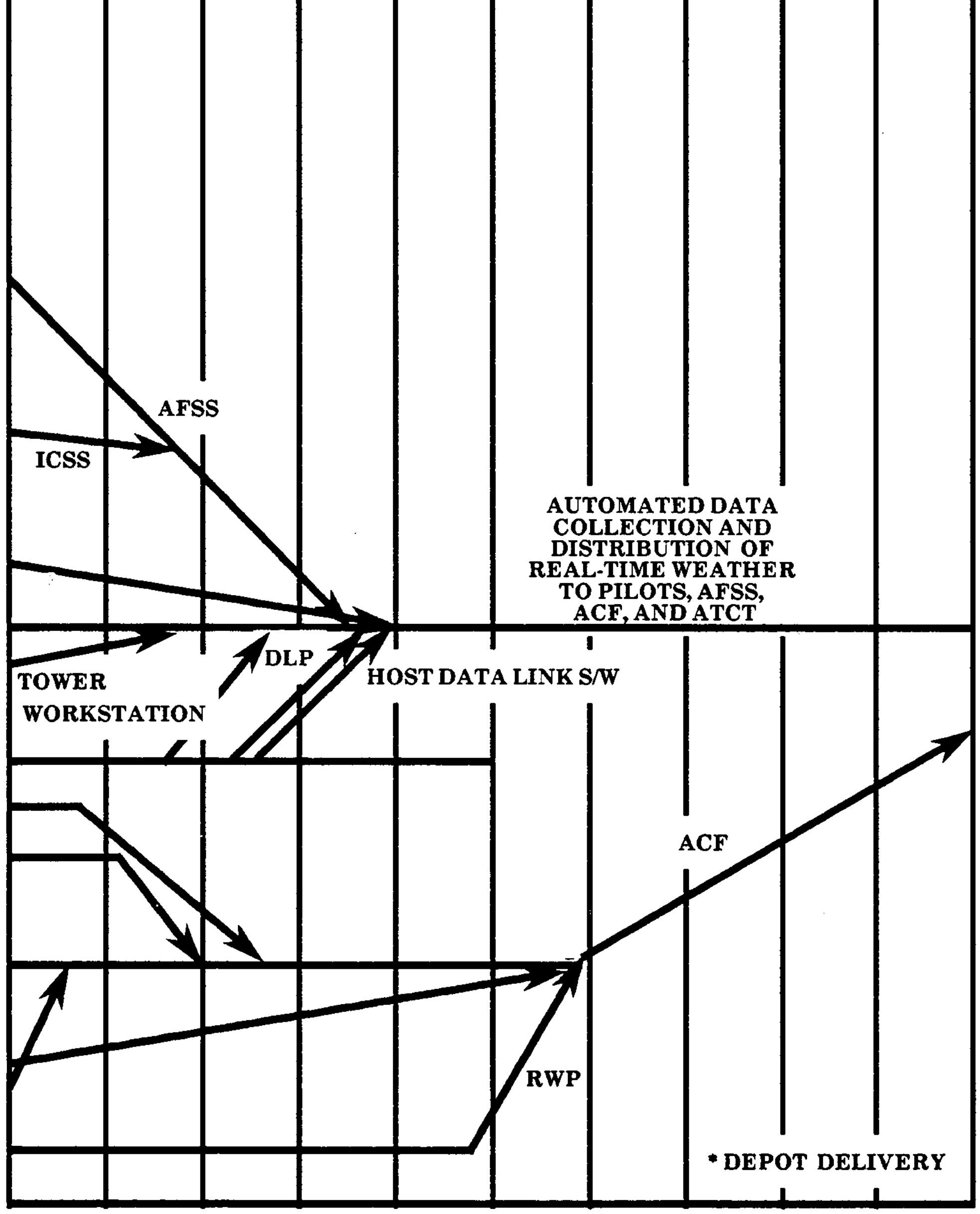
Automated weather information will be available via data link to pilots down to 12,500 feet mean sea level and at designated terminal areas by 1994. Coverage will be extended down to 6,000 feet mean sea level by the year 1996. Request/reply will be provided as well as the transmittal of significant meteorological reports.

FSDPSs and 39 AFSSs). Model 1 Full Capacity contract modification completed.

- IVRS became operational.
- International and domestic CNS operational.
- HIWAS project completed.
- EFAS contract awarded and implementation initiated.
- LLWAS basic implementation complete. Contracts awarded and implementation initiated for 6 sensor improvements and LLWAS network expansion.
- GOES project completed.
- RRWDS completed.
- CWP project replanned. RWP specification completed.
- AWOS commercial systems contract awarded.
- ICSS Phase IA contract awarded. Phase I completed.
- Aeronautical Data Link Processor (DLP) contract awarded.
- WMSC Replacement contract awarded.



IVRS
GOES
FSS DATA
COLLECTION/VOICE DISTRIBUTION
CNS
ICSS
HIWAS*
AWOS
TRACON/ATCT DATA
COLLECTION/VOICE DISTRIBUTION
BASIC
LLWAS
LLWAS
MODIFICATIONS
WIND SHEAR EFFORTS
WEATHER SERVICES VIA MODE S DATA LINK
ADAS
WMSC REPLACEMENT
RRWDS
ARTCC DATA
COLLECTION/VOICE DISTRIBUTION
NEXRAD
MWP
CENTRAL WEATHER PROCESSOR
LEGEND:
R & D
F & E
IMPLEMENTATION
DURATION



FLIGHT SERVICE AND WEATHER SYSTEMS EVOLUTION

works providing required coverage with a reduced number of separate facilities and at reduced cost.

- Microwave landing systems (MLS) will replace instrument landing systems (ILS) and provide multiple, curved, and segmented approaches and selectable glide angles.

- A discretely addressable surveillance capability (Mode S) with an integral data link will replace the present ATC radar beacon interrogator systems at most terminal and en route surveillance sites.

The ground-to-air system, based on a networking concept, will provide nationwide service and coverage for surveillance, navigation, and voice and data link communications. Adequate coverage will be assured and additional navigation and surveillance provided as traffic demands warrant.

En route surveillance coverage, as traffic density requires, will be provided down to 6,000 feet msl or minimum instrument flight rules altitude (whichever is higher) and to the surface of qualifying airports. The network is comprised of solid-state en route and terminal search and beacon systems. Department of Defense requirements at joint surveillance sites will be met by using a national perimeter of new three-dimensional minimally attended radar systems.

Search radar will be retained for FAA weather and air traffic control requirements through the 1990's. Weather detection provided by en route search radar will gradually be replaced by the next generation weather radar (NEXRAD).

By 1994 Mode S and data link coverage will be provided down to 12,500 feet msl and to the surface

facilities) will be added in a limited number for new navigation qualifiers only.

Solid-state ILS components will be installed to meet maintainability requirements.

En route and flight service station (FSS) voice communications coverage will be provided down to 2,000 feet above terrain. Terminal voice communications will be provided to the surface at designated airports. Existing and future radio-frequency requirements will make conversion of ground and airborne systems to 25 kHz spacing necessary.

ACCOMPLISHMENTS

- ARSR 4 contract awarded.

- ARSR tube-type upgrade first implementations completed.

- ASR 9 implementation has begun.

- Mode S contract awarded and four units under test.

- VOT and ILS component replacement and communication consolidation being implemented.

- ASDE first production units completed.

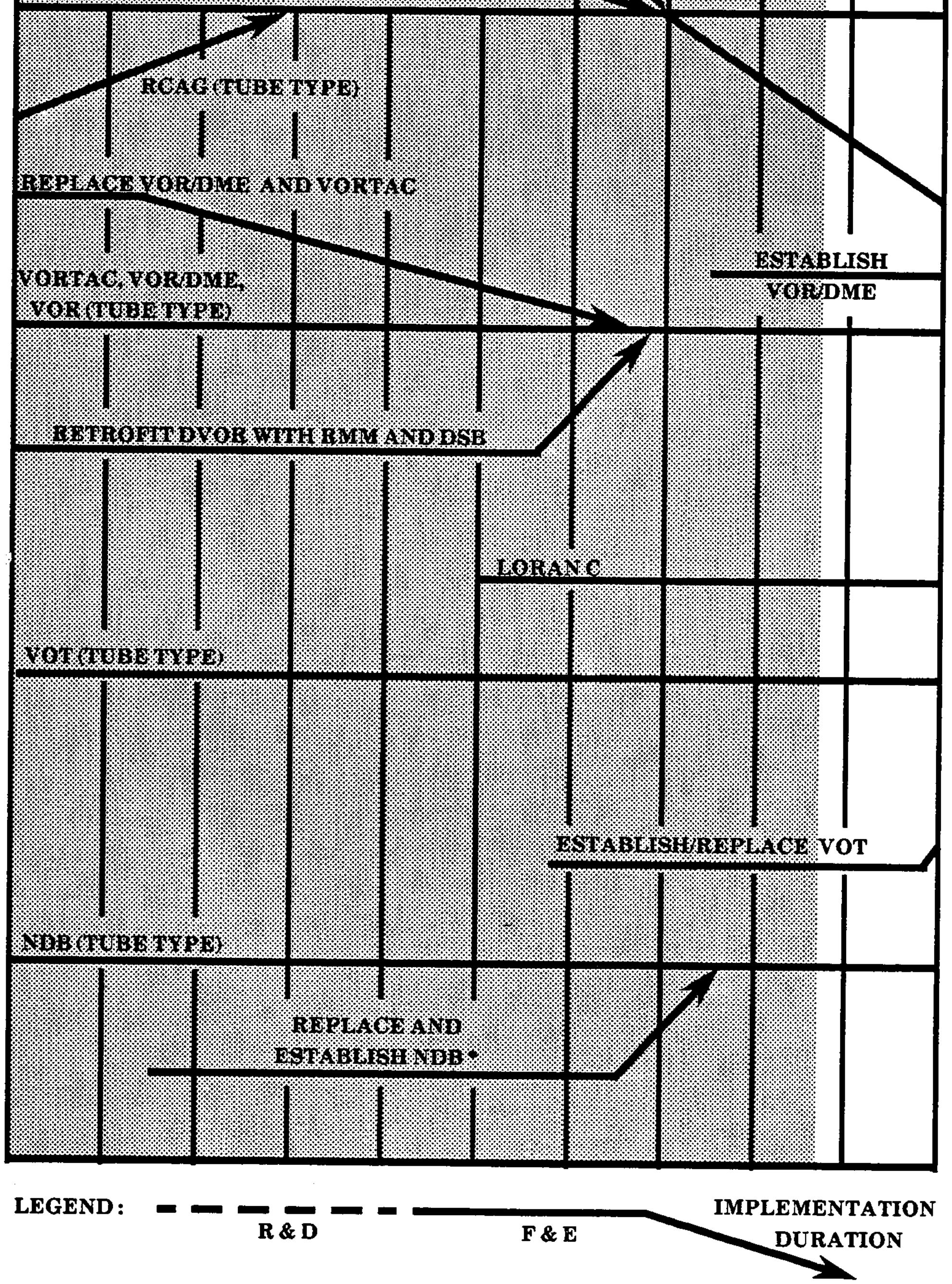
- NEXRAD operational support facility established.

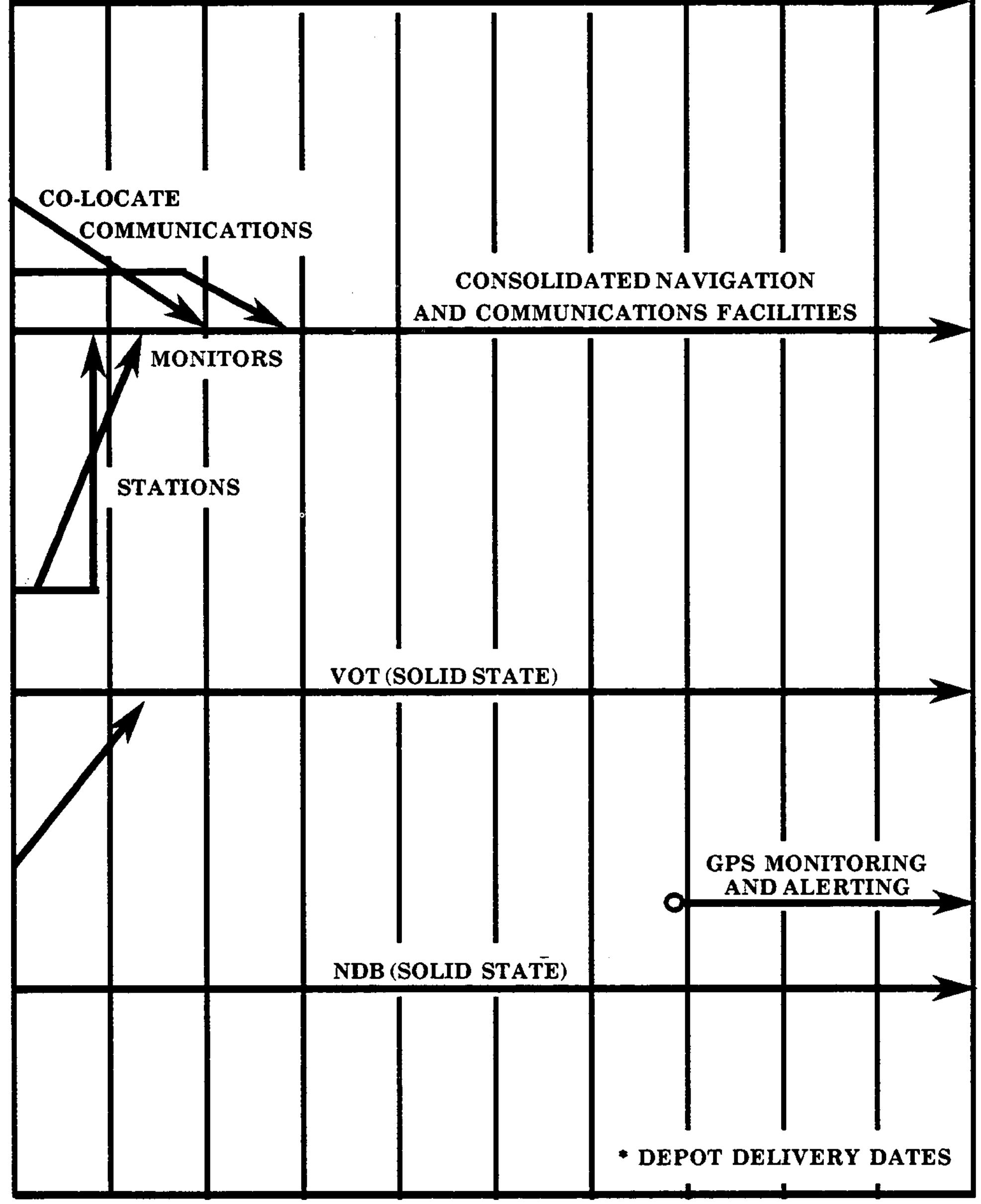
- TDWR contract awarded.

- ILS project completed.

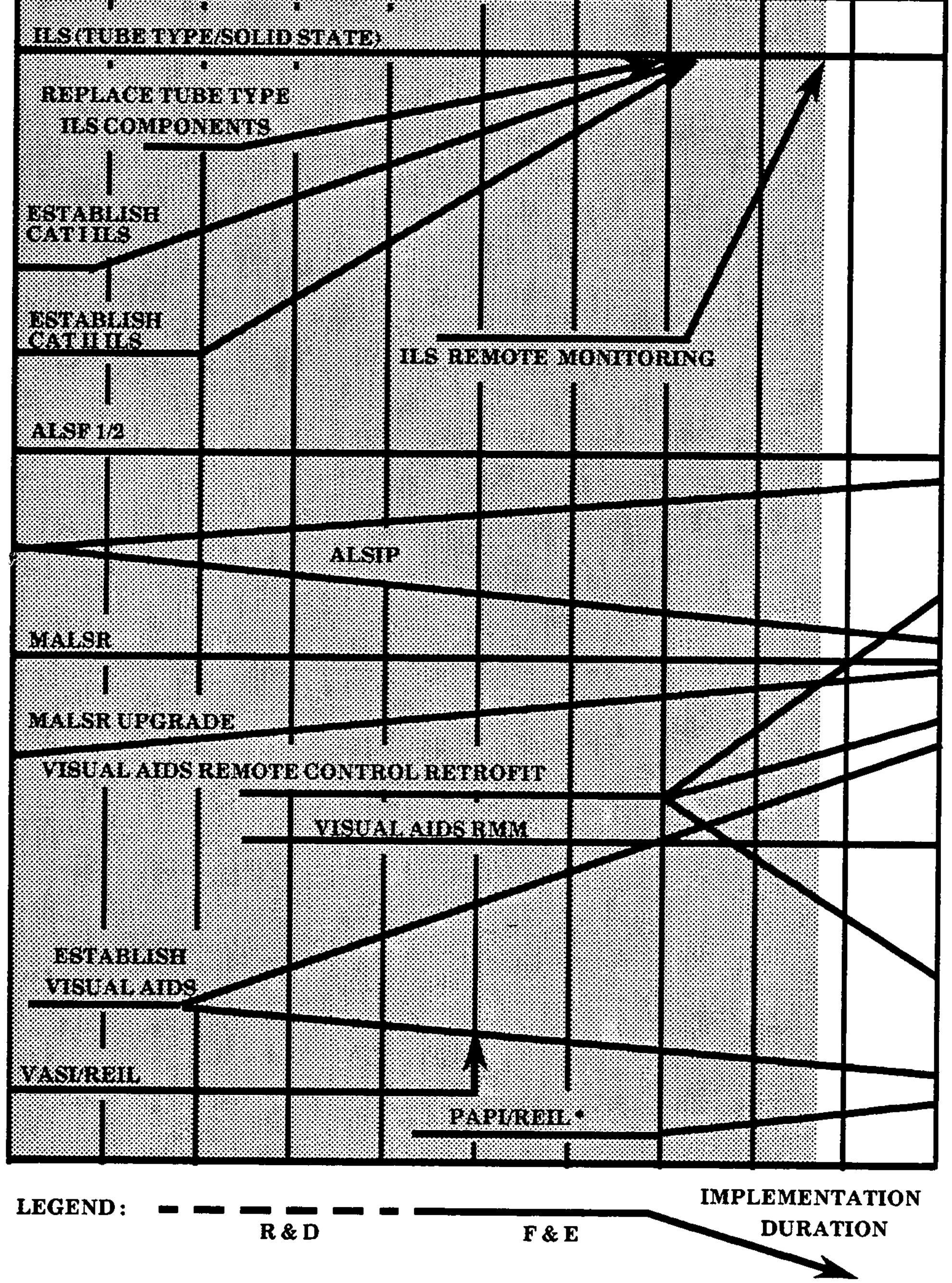
- NDB project completed.

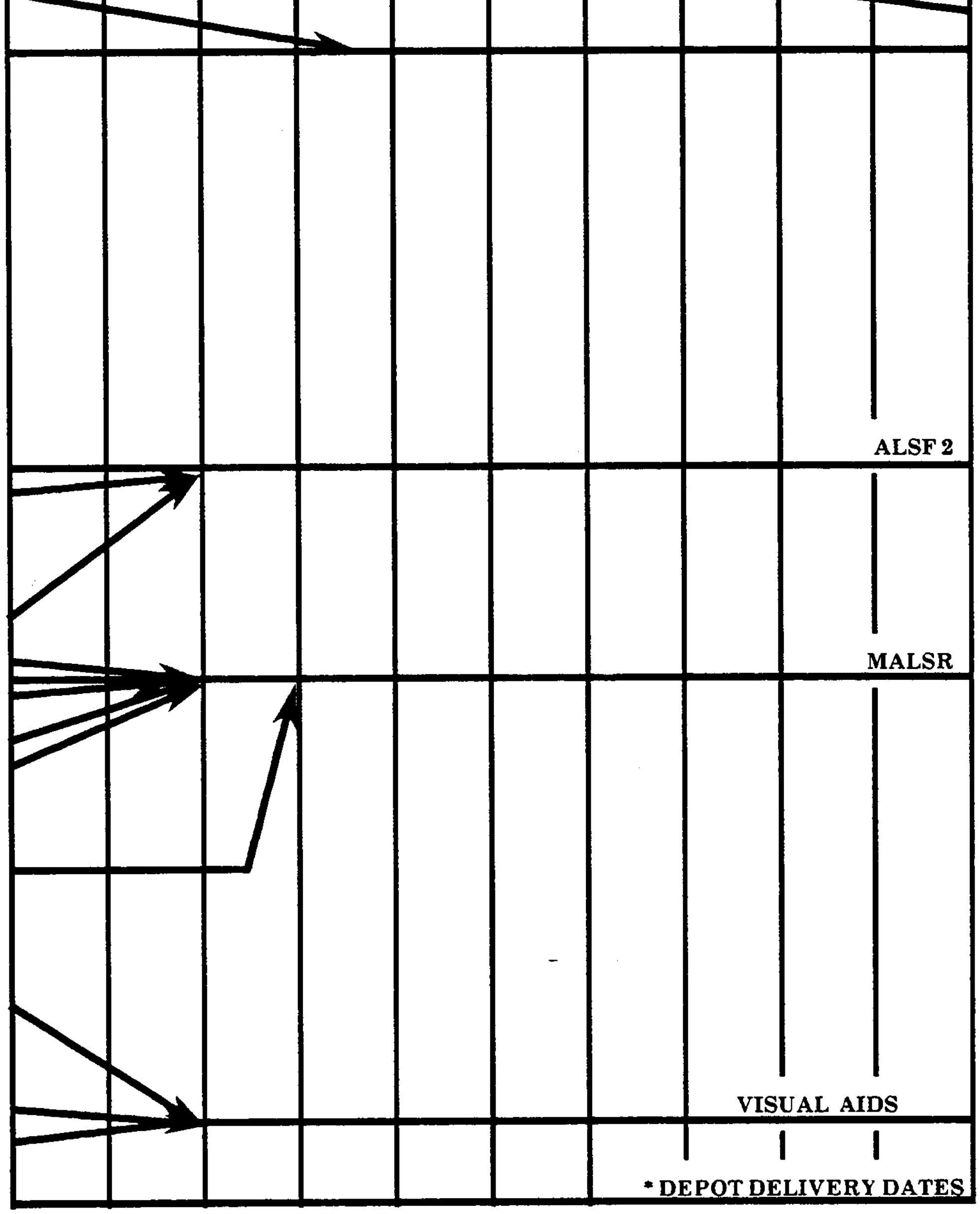
pleted.


RCAG (TUBE TYPE)
REPLACE VOR/DME AND VORTAC
VORTAC, VOR/DME, VOR (TUBE TYPE)
ESTABLISH VOR/DME
RETROFIT DVOR WITH RMM AND DSB
LORAN C
VOT (TUBE TYPE)
ESTABLISH/REPLACE VOT
NDB (TUBE TYPE)
REPLACE AND ESTABLISH NDB *
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION

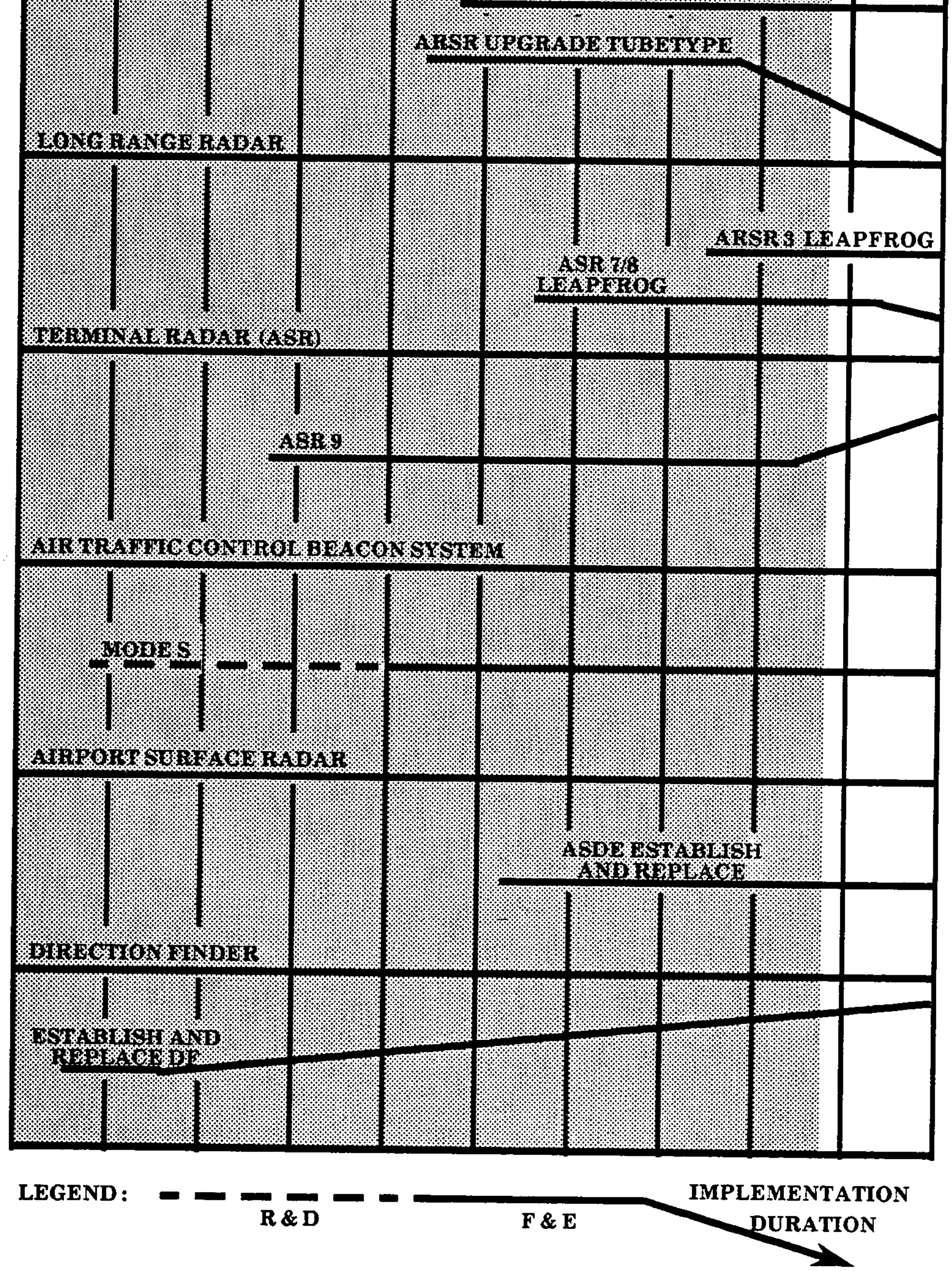


NAVIGATION AND COMMUNICATIONS SYSTEM EVOLUTION

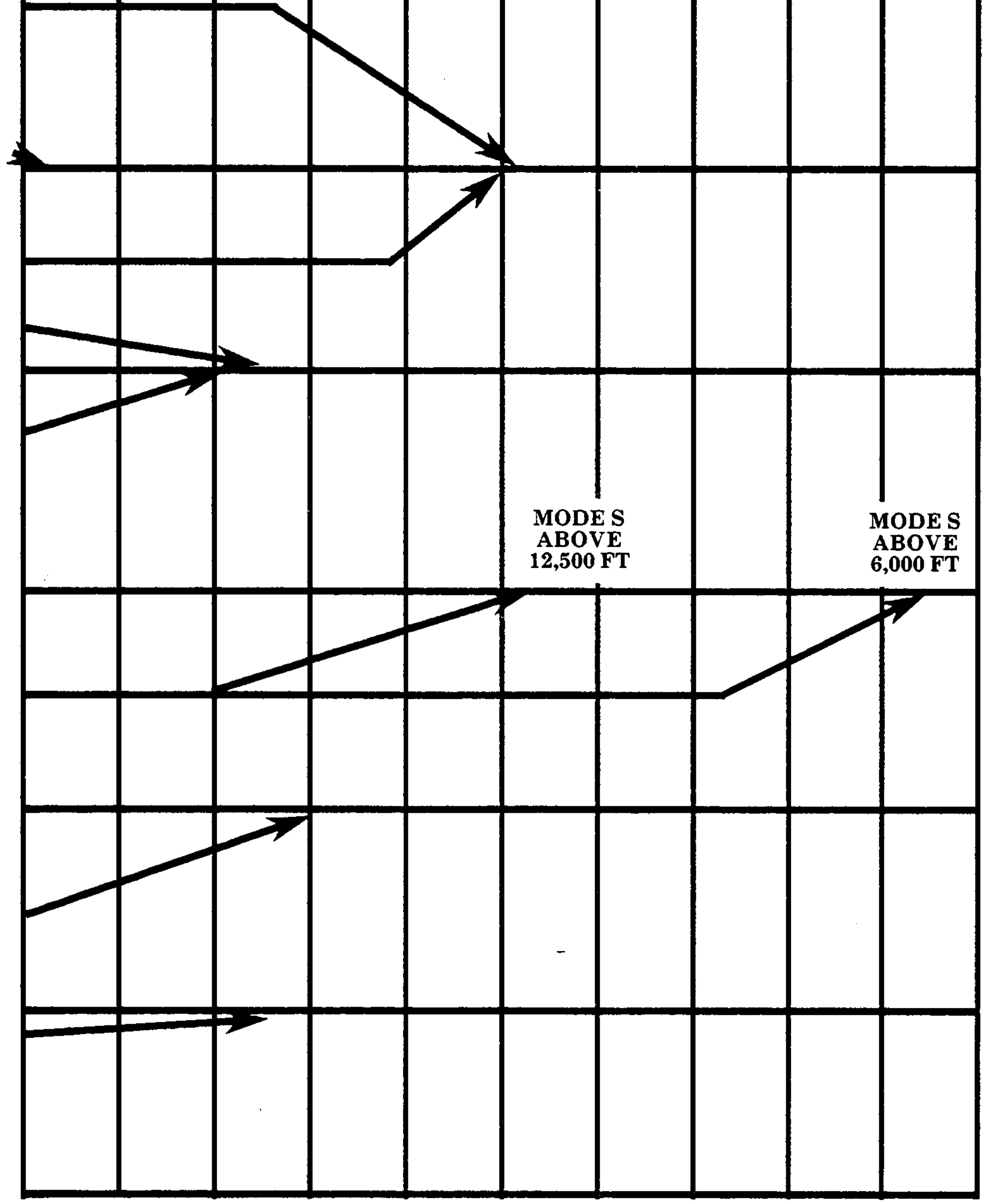

ILS (TUBE TYPE/SOLID STATE)
REPLACE TUBE TYPE
ILS COMPONENTS
ESTABLISH
CAT I ILS
ESTABLISH
CAT II ILS
ILS REMOTE MONITORING
ALSF 1/2
ALSIP
MALSR
MALSR UPGRADE
VISUAL AIDS REMOTE CONTROL RETROFIT
VISUAL AIDS RMM
ESTABLISH
VISUAL AIDS
VASI/REIL
PAPI/REIL *
LEGEND:
R & D
F & E
IMPLEMENTATION
DURATION



LANDING SYSTEMS EVOLUTION



ARSR UPGRADE TUBETYPE
LONG RANGE RADAR
ARSR 3 LEAPFROG
ASR 7/8 LEAPFROG
TERMINAL RADAR (ASR)
ASR 9
AIR TRAFFIC CONTROL BEACON SYSTEM
MODE S
AIRPORT SURFACE RADAR
ASDE ESTABLISH AND REPLACE
DIRECTION FINDER
ESTABLISH AND REPLACE DF
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



SURVEILLANCE SYSTEMS EVOLUTION

- The total network will provide a communication system at significantly lower operating costs.

- There will be a mix of owned and leased switching and transmission facilities.

- Both terrestrial and satellite transmission facilities will be used.

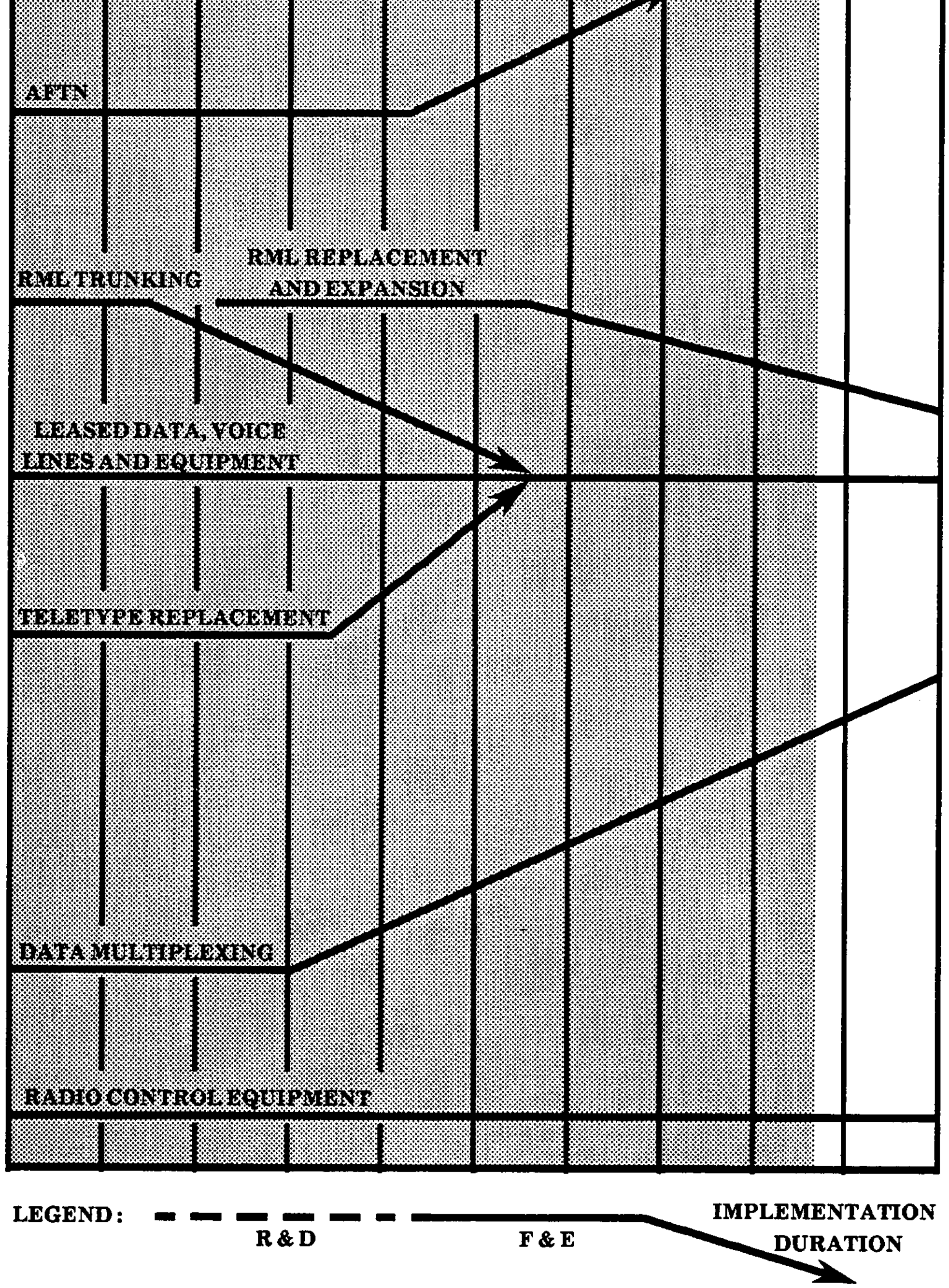
- Existing microwave links will be replaced with highly reliable, low-maintenance equipment.

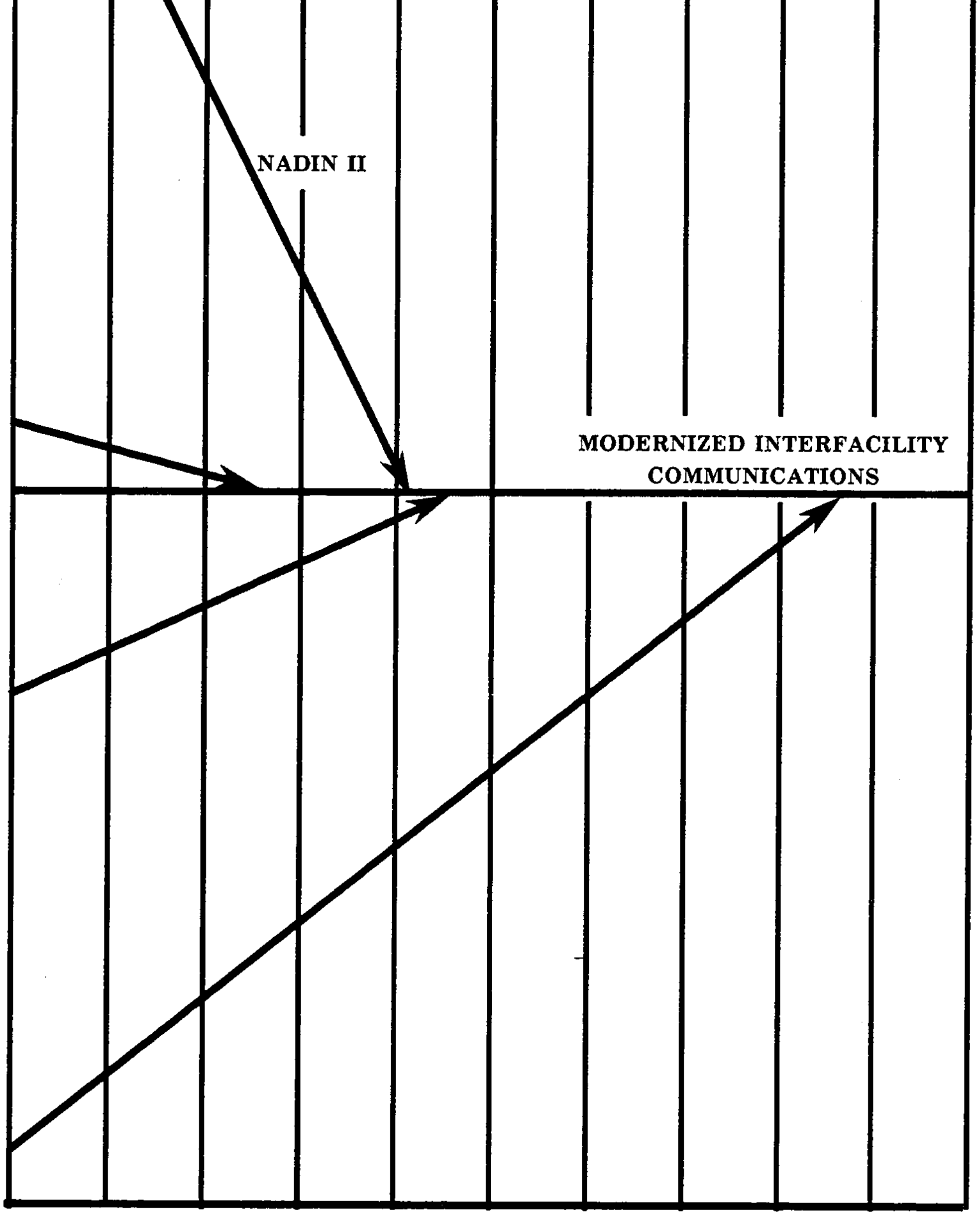
- Teletypewriter replacement complete.

- RCE contracts awarded.

- Fiber optic, RF link tests, RF link specifications, and equipment selection criteria for airport telecommunications completed.

- NADIN II contract awarded.


AFTN
RML TRUNKING
RML REPLACEMENT
AND EXPANSION
LEASED DATA, VOICE
LINES AND EQUIPMENT
TELETYPE REPLACEMENT
DATA MULTIPLEXING
RADIO CONTROL EQUIPMENT
LEGEND:
R & D
F & E
IMPLEMENTATION
DURATION



INTERFACILITY COMMUNICATIONS SYSTEMS
EVOLUTION

- Consolidation of work centers and manned facilities.

- Lower staffing levels made possible by remote maintenance monitoring.

- Lower support costs for FAA-owned housing and plant facilities.

- Improved field training via computer-based instruction.

Flight inspection expenditures will be contained through:

- Consolidation of flight inspection field offices.

- Modernization of the FAA aircraft fleet and flight inspection capabilities.

The objective is to provide improved services at less operational costs by modernizing the flight inspection program and by implementing the Maintenance Program for the 1980s.

The following are representative of these programs:

- The flight inspection modernization program replaces the current aircraft fleet with fuel-efficient aircraft, provides an automated flight inspection system, upgrades associated services, and improves the process.

- The Maintenance Program for the 1980s is a significant commitment to modify maintenance practices and consolidate the location of work stations, thereby reducing staffing requirements.

for costly government housing and support services at certain remote areas.

ACCOMPLISHMENTS

- AF sectors have been reduced from 115 to 79.

- MPSs have been purchased (38) and installed and enhancements initiated.

- GNAS MCC and ARTCC MCC prototypes have been established.

- VOR/VORTAC equipped with RMM have been installed.

- ARTS III PCS contract awarded. Field installation is underway.

- FIFOs have been consolidated (seven to five).

- NARACS backbone is complete and implementation of the Eastern and Western networks initiated.

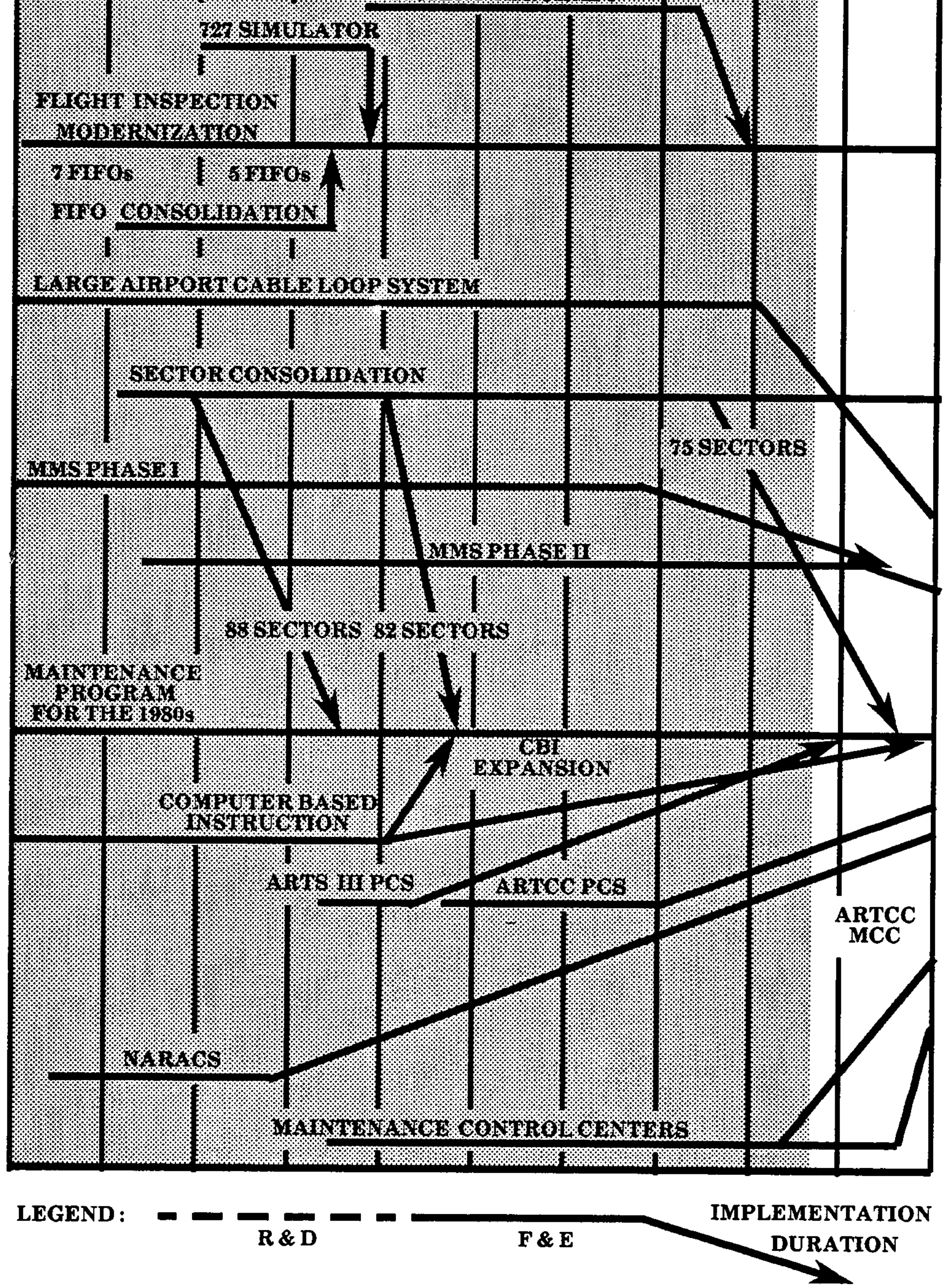
- System engineering and integration contractor is on board and providing support for implementation of the NAS Plan.

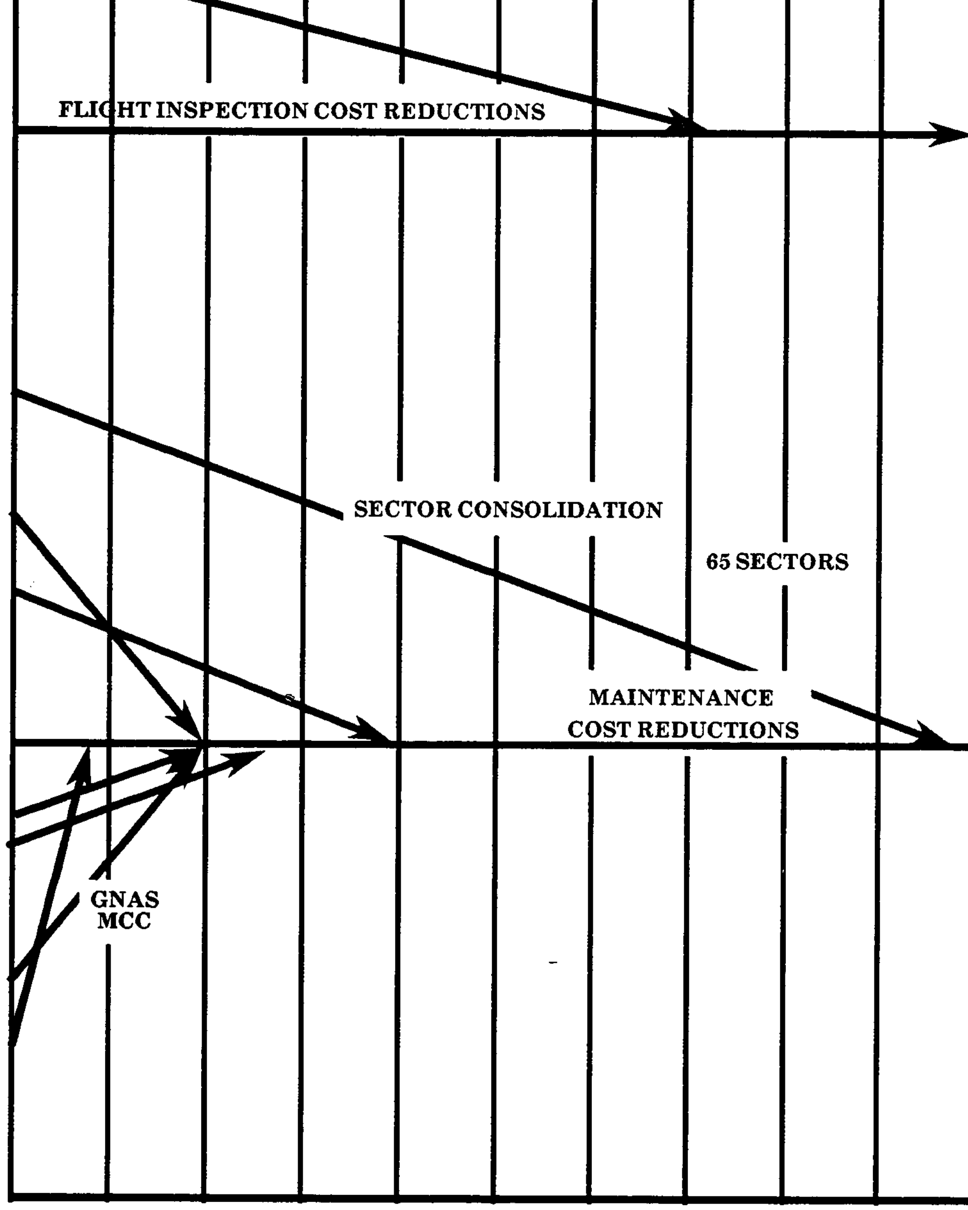
- Action underway to provide 3-level weather data on ARTCC controller displays.

- Heliport established in support of the General Support Laboratory at the FAATC.

- Aircraft Fleet Conversion/Flight Inspection Modernization Project completed.

- Navigational computer units and spectrum analyzers delivered for update of flight inspection aircraft fleet.


727 SIMULATOR
FLIGHT INSPECTION MODERNIZATION
7 FIFOs
5 FIFOs
FIFO CONSOLIDATION
LARGE AIRPORT CABLE LOOP SYSTEM
SECTOR CONSOLIDATION
75 SECTORS
MMS PHASE I
MMS PHASE II
88 SECTORS
82 SECTORS
MAINTENANCE PROGRAM FOR THE 1980s
CBI EXPANSION
COMPUTER BASED INSTRUCTION
ARTS III PCS
ARTCC PCS
ARTCC MCC
NARACS
MAINTENANCE CONTROL CENTERS
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS EVOLUTION

requirements of the NAS. Both near-term and long-term efforts are discussed, with varying levels of maturity associated with each effort. Project maturity is proportional to expected implementation dates.

Long-term efforts require additional analysis before decisions are final. They have been included to acquaint the reader with FAA perceptions on future needs. As other aeronautical research and technology initiatives mature, current plans may change and additional plans for capital expenditures may be developed.

ACCOMPLISHMENTS

- Contract awarded for supplemental ILS systems.
- Specification for parallel runway monitors under development.
- Learning stations (GFE) provided to AAS contractor.
- Fuel storage tank clean-up effort started.
- Telecommunications support effort started implementing airport telecommunications.

TRANSITION

Planning and system design of the NAS must be responsive to the broad combinations of technical, operational, and human resource capabilities which are in turn, responsive to the needs of the user community. In transition to the long-range objectives of the NAS Plan, the continued safe and efficient operation of the ATC system must be maintained.

The transition chapter, with new content in this year's publication, supplements the NAS Plan long-the national air commerce system.

The projects in Chapter VIII are printed on blue pages, as are those in Chapter VII, to distinguish them as an adjunct to the NAS Plan.

The projects listed in Chapter VIII complement projects in Chapters III-VI by providing the means to achieve the advances forecast in those projects.

ACCOMPLISHMENTS

- Southern California Terminal Airspace Realignment complete.
- Los Angeles Basin Service Consolidation underway.
- Planning initiated for a new airport at Denver, Colorado.
- Planning started for modernization of airspace in Dallas/Ft. Worth, Texas.
- Planning/engineering underway for Chicago area improvements.
- HRM action plan published.

DOD/FAA OPERATIONS

The Department of Defense (DOD) plays a large role in the NAS as a provider of Air Traffic Control (ATC) services and a major user of all NAS ATC services. The DOD is substantially affected by and must be a full participant in the NAS Plan. Chapter IX describes the DOD goals, assumptions, and planning activity relating to their interface with the FAA NAS Plan activities.

ning; and advanced technological development and evaluation.

The plan has been developed by representatives of FAA in cooperation with representatives of the aviation industry and the flying public. It contains projects similar in appearance to those of the National Airspace System Plan for Facilities, Equipment, Associated Development and Other Capital Needs (F&E), but addresses the larger area of research, engineering, and development interests. Projects contained in the NAS Plan for F&E, which have research and development components, are included in the FAA Plan for R,E&D. Additionally, R,E&D activity which may yield systems and equipment to be included in future editions of the NAS Plan for F&E are also contained in the R,E &D Plan.

ROTORCRAFT MASTER PLAN

The FAA Rotorcraft Master Plan defines the requirements and associated research and development efforts relating to producing facilities, airborne equipment, and procedures designed to solve the specific problems encountered by rotorcraft. These efforts will build upon the systems used for fixed-wing aircraft. Results will provide a cost-effective approach to meet the needs of both aviation users.

the National Airspace System. The National Plan of Integrated Airport Systems is prepared in coordination with the NAS Plan. It is published every two years. The next publication is scheduled for December, 1989.

THE ENHANCED NATIONAL AIRSPACE REVIEW

The National Airspace Review (NAR) is a cooperative effort between Government and industry to improve the safe and efficient use of the Nation's airspace. The original efforts of the NAR have been completed, and its scope has been expanded to include a review of the airspace, procedural, and regulatory aspects of scheduled improvements envisioned under the modernization of the National Airspace System (NAS), and it is now identified as the NAR Enhancement Plan.

The National Airspace System Plan identifies capital improvements needed to safely meet the projected demands on air transportation between now and the year 2000. The NAR Enhancement Plan, in relationship to the NAS Plan, focuses on airspace and procedural aspects of the air traffic control system for the purpose of identifying the long-term operational considerations of, and potential adjustments to, an enhanced system as it evolves. To accomplish this, the NAR Enhancement Plan is conducting additional in-depth studies to identify, analyze, and document recommended changes which will be assessed to establish validated requirements for the system. This effort will provide the operational framework for a smooth transition into the next generation NAS with an accelerated realization of benefits. The work of the NAR was completed in late 1984 and the work of the NAR Enhancement Plan commenced in early 1985.

- TCAS (traffic alert and collision avoidance system) will provide independent airborne backup to the separation function of the air traffic control system.

- A major computer/data processing system (including a new sector suite and new system software) will be procured. The new system will support en route and terminal functions and allow for consolidation.

- The highest practical level of air traffic control automation will be implemented.

- A modernized traffic flow management process will be implemented.

- Secondary surveillance radar (SSR) Mode S, with its integral data link, will replace the air traffic control radar beacon system (ATCRBS) at most locations.

- A new weather radar network will be provided for the air traffic control system. It will include NEXRAD and a terminal radar weather channel (ASR 9).

- A terminal Doppler weather radar system will be provided where needed to detect microbursts and wind shear in the path of landing and departing aircraft.

- FAA will proceed with upgrading ARTS II and ARTS III (automated radar terminal system).

- A major improvement and integration of the FAA communications system will be implemented.

- The automated flight service station system will be implemented, along with a major improvement in weather services to users.

- FAA will proceed with extensive consolidation of facilities and the removal of the impact of artificial system boundaries on users.

- A major system engineering and integration contractor was employed to assist the FAA in the accomplishment of the the NAS Plan.

- A national technical support services contract was awarded to augment the Regional workforce and supplies in NAS Plan project accomplishment.

IMPLICATIONS FOR FAA PERSONNEL

The NAS Plan efforts will not only result in increased safety, user efficiency, and significant economies, but also in increased job satisfaction for FAA personnel. Both adequate capital resources and the personal commitment of field, center, regional, and headquarters employees are essential for the successful implementation of the Plan. The individual involvement of ATC specialists and AF technicians is necessary for optimum operating systems. FAA personnel should expect implementation of the Plan to enhance job satisfaction by replacing processes based on obsolete technology and routine repetitive manual tasks with ones supported by automation and the latest technology.

Some of the more notable implications for ATC specialists are:

- Improved traffic flow planning and management, resulting in a more balanced workload.

- Reliable equipment, which minimizes the stress of equipment failure.

- Easier access to more timely data, allowing for improved service to the flying public.

specifications, leading to improved interaction and information transfer between team members.

- Automation of certain procedures to reduce workload.

- Enhanced displays with color and improved weather data.

The more significant implications for AF technicians are:

- Upgrading of individual skills to match the current technology.

- Improved analytical tools for more effective diagnosis and repair.

- Automation of maintenance/monitoring techniques to reduce workload.

- Improved field communications capability.

- Emphasis on human factors engineering for less manpower-intensive maintenance.

- Increased flexibility in routing.

Although no additional equipment will be required for most new services, users will need to purchase certain avionics related to TCAS, Mode S data link, MLS, and 25 kHz communications in order to maximize their benefits. The cost of these avionics will be borne by the user.

The following new requirements are anticipated to permit full participation in the system:

- ILS will be supplemented with, and subsequently replaced by MLS where needed. Airborne equipment will be needed to use this new service, with the need for a number of aircraft to carry dual ILS/MLS avionics during the transition.

- It is expected that pilots who wish to receive full ATC service in all controlled airspace will need 720-channel VHF communications capability in their aircraft.

tions will be accommodated with a minimum of constraint and with the highest practical fuel efficiency. Dynamic flow management will reduce airborne delays.

EQUIPMENT BASE

Automation, navigation, surveillance, and landing system equipment will employ up-to-date technology. Like functions will utilize like equipment. A national network of facilities based on actual demand patterns and maintenance requirements will be in place. An efficient communications network will support individual facilities.

CONSOLIDATION

Fewer major manned control facilities will be required. Remote facilities will also be consolidated. Unique facilities as well as unique equipment types will be eliminated. The consolidation of facilities will reduce overhead costs. The logical grouping of compatible services using standardized communications, computer, and display elements (where practicable) will achieve efficiency and economy.

NAS PLAN BENEFITS

The completion of the National Airspace System Plan will bring about operational cost efficiencies and productivity gains. Implementation of the Plan will offset the FAA costs required to meet increasing demands of air traffic growth in a system which will be otherwise inadequate to handle them. These offsetting effects will allow the FAA to operate the the typical life cycle of ATC equipment (20 years).

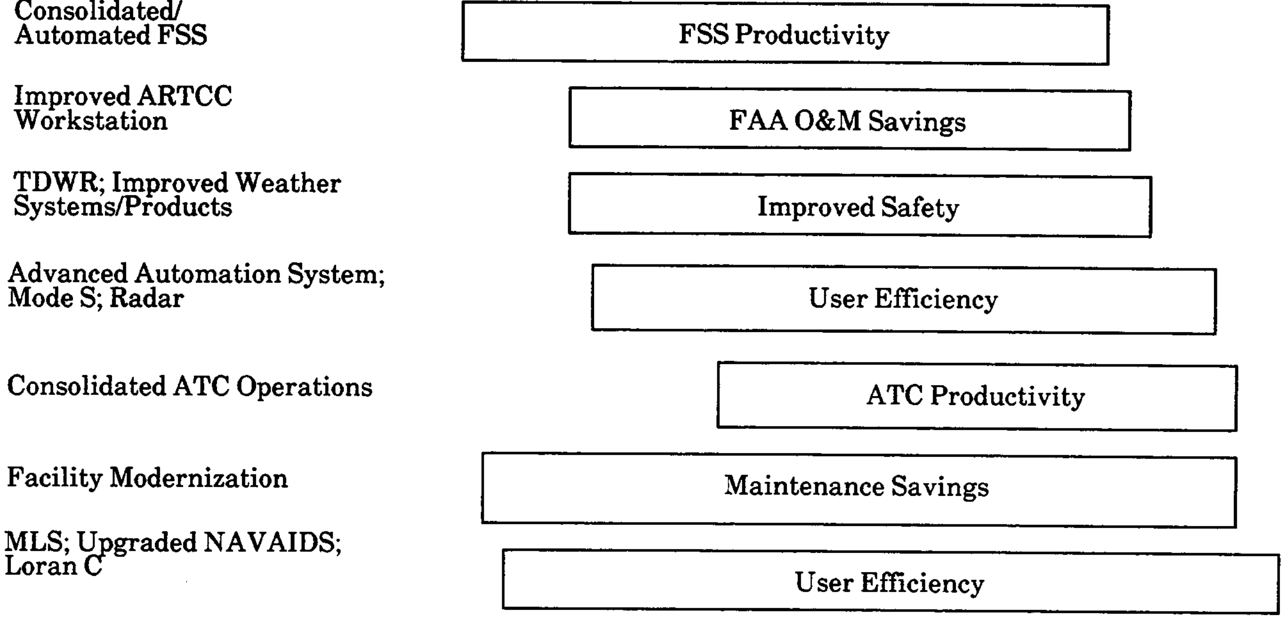
The total value of the benefits resulting from the NAS Program implementation is estimated at $114.2 billion 1981 constant dollars (this assumes procurement of 960 MLSs by the year 2000). This represents the economic value of the pursuit of NAS Plan goals to increase FAA productivity and reduce workload while meeting demand with fewer constraints, fuel efficiency and improved safety.

In addition to its economic value, the Plan will bring technical modernization and sophistication to the ATC system infrastructure, making it expandable, more flexible and responsive to operators and users, including operational preferences in human engineered ATC automation.

AAS, AERA, and related projects such as the Voice Switching and Control System (VSCS), Mode S, Central Weather Processor (CWP), and the Advanced Traffic Management System (TMS) collectively account for the majority of airspace system user efficiency benefits. Supporting these hardware and software resources are the surveillance capabilities provided by Mode S and an improved radar network which provide more accurate and comprehensive positional data for improved traffic management. Weather projects which contribute improved sensor detection and real-time information dissemination capabilities are other contributors to delay reductions. MLS and AAS/AERA reduce procedural restrictions on aircraft operating in and out of terminal airspace.

NAS safety record in the terminal environment by meeting the growth in demand for precision approach aids at newly qualifying runways by the year 2000. Other NAS projects which make substantial contributions are those which improve aircraft surveillance, and provide enhanced weather detection and information distribution. Mode S and Air Route Surveillance Radar (ARSR 4) are among the projects that increase the likelihood that conflict situations will be identified and corrected before aircraft are placed at risk. Projects such as the Automated Weather Observing System (AWOS), Next Generation Weather Radar (NEXRAD), Terminal Doppler Weather Radar (TDWR), and the Aeronautical Data Link monitor weather conditions with operations involving adjacent facilities.

Airway Facilities (AF) maintenance costs will be reduced through improved reliability and maintainability inherent in new or modernized hardware/software (e.g., solid-state devices are inherently more reliable than their vacuum tube counterparts) and improved maintenance diagnostics that are designed into such facilities (i.e., built-in test equipment). These developments will result in lower AF staffing requirements, reductions in diagnostic and repair equipment requirements, and elimination of parts inventories required to support equipment that is no longer in production.



NAS PLAN LIFECYCLE BENEFIT STREAMS
(PRIMARY BENEFIT)

OPERATIONS COST

Costs shown on the table below are in 1981 dollars and reflect the expected annual operations costs for each of the years listed. Costs are in millions of dollars. Outyear estimates of operations costs are reviewed annually and are subject to revision.

	1981	1985	1990	2000
Air Traffic Personnel	$ 847	$ 757	$ 856	$ 690
Airway Facilities Personnel	$ 369	$ 330	$ 318	$ 264
Leased Communications	$ 93	$ 130	$ 197	$ 356
Rents, Utilities, Other	$ 102	$ 131	$ 195	$ 239
Totals	$ 1,411	$ 1,348	$ 1,566	$ 1,549

integrated system.

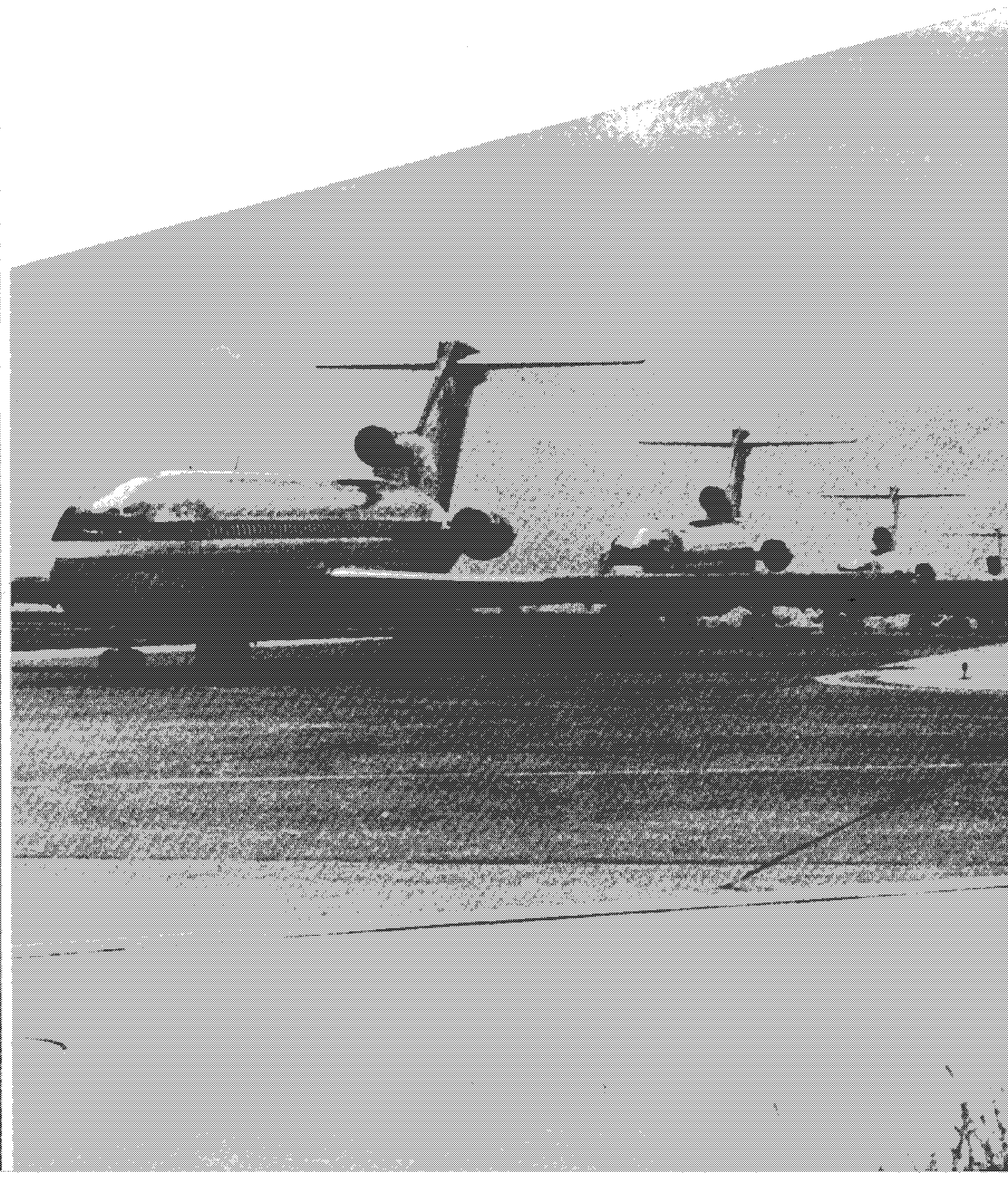
- Ensure no degradation or loss of existing services.
- Improve services where deficiencies exist.

cable.

The Plan requires annual funding in order to be executed efficiently. There will be continuous Executive and Legislative oversight, but a continuing commitment to the funding levels requested by the President is necessary to execute the Plan.

CHAPTER II

DEMAND ON THE SYSTEM



DEMAND ON THE SYSTEM

The United States National Airspace System is the busiest and most complex in the world. The airspace accommodates over 240,000 active civil and military aircraft. Performance characteristics of these aircraft vary widely and the missions flown have differing impacts on the system. The overall trend is toward the production of more sophisticated aircraft which make greater use of controlled airspace and the services which FAA provides.

The continuing growth in aircraft operations, diversity of operations, number of aircraft, and sophistication of aircraft will place unprecedented demands on the National Airspace System from now through the turn of the century. In addition, the full effects of the Deregulation Act of 1978 and the resulting increase in competitive scheduling, lower prices, new airline entries, and airport hubbing will continue to place extra demands on the system. The safe and efficient operation of the National Airspace System will require improved services, new facilities for system expansion, orderly replacement of aging facilities, and provision of adequate airport capacity.

Despite its high level of safety, the National Airspace System is not without difficulties. Problems of expanding capacity at congested airports, the provision of more direct routings, and the accommodation of greater numbers of sophisticated aircraft must be dealt with effectively.

GENERAL SYSTEM DEMAND

Forecasts indicate that demand in terms of aviation activity will increase substantially in the next two decades. Table I depicts the growth anticipated in aviation demand for the years 1990, 1995, and 2000.

OPERATIONS AND ENPLANEMENTS

Aircraft operations, including takeoffs and landings at all towered and nontowered airports in the National Airport System Plan (NASP) (the forerunner to the National Plan of Integrated Airport Systems (NPIAS)), were anticipated to grow by 45 percent between 1982 and 2000, with itinerant operations increasing 64 percent. Itinerant operations refer to those aircraft departing to or arriving from an area outside an airport's local operating area. A breakdown of aircraft operations for the different types of civil airports can also be found in Tables II and III. Table IV provides information concerning military-owned and operated airports Instrument operations represent a separation service provided to aircraft while conducting flight in accordance with instrument flight rules (IFR). In the terminal area, IFR separation services are provided either by the air route traffic control center (ARTCC) or terminal approach facility, and are expected to increase by 92 percent. Enroute service into and from terminal areas is provided by the ARTCC and is expected to increase by 71 percent. Flight service station (FSS) operations, including pilot briefings, flight plan origination, and aircraft contacted, will decrease by 23 percent. Domestic enplanements include all enplanements for the activity indicated, regardless of airport type. Air carrier domestic enplanements are expected to increase by 155 percent and commuter enplanements by 269 percent.

AIRCRAFT HOURS, FLEET, AND PILOTS

Air carrier hours flown are forecast to increase 120 percent, general aviation hours flown to increase 2 percent, and military hours flown to increase 13 percent. The number of air carrier aircraft will increase by 92 percent, commuter aircraft by 50 percent, general aviation by 3.7 percent, and the helicopter fleet by 47 percent (see Table I.)

The mix of the general aviation fleet will be altered dramatically during this period. The single-engine piston fleet, which normally operates visual flight rules (VFR) below 12,000 feet, will decrease from 172,000 to 162,000 aircraft. The more sophisticated twin-engine and turbine-powered aircraft will comprise the fastest growing segment of the fixed-wing fleet, increasing from 34,500 to 39,000 aircraft. The number of pilots will increase by 3 percent, but those with instrument ratings will grow by 22 percent.

MILITARY AVIATION REQUIREMENT

Response to military requirements places special demands on the National Airspace System, particularly in the en route airspace. The FAA also provides approach control services for over half of the 233 military airfields in the United States. This service is in addition to over 50 approach control facilities and 180 control towers that are operated by the military. The Department of Defense operates over 20,000 aircraft within the National Airspace System, flying approximately 6 million hours a year. Over 90 percent of this flying is dedicated to training missions. These training missions include high-speed maneuvering flight in all altitude bands, with increasing need for very low-level operations. Increased air refueling activity, air drop missions, and frequent large-scale joint exercises require close coordination with civil traffic flows. The increased speed, range, and capabilities of military flight operations also indicate that a higher level of demand will be placed on the National Airspace System for training and testing, even though the total number of military aircraft will remain relatively constant. A relatively small amount of airspace is reserved exclusively for military use. Therefore, there will be a need for continued coordination and improved navigation and air traffic control service as growing civil aviation and military aviation requirements must be accommodated within common airspace.

TABLE I. TOTAL NATIONAL AIRSPACE SYSTEM ACTIVITY

	1982	1985	1990	1995	2000	Percent Growth 1982-2000
NPIAS Airports *	3195	3219	3472	3600	3750	17.4
Airport Operations (millions)						
Aircraft Operations	127.6	143.0	146.1	165.6	185.1	45.1
Itinerant Operations	68.0	78.8	86.0	98.9	111.6	64.1
Instrument Operations	31.7	38.7	47.7	55.1	61.0	92.4
Towered Airport Operations	50.6	57.9	64.0	72.5	80.2	58.5
ARTCC Operations (millions)						
IFR Aircraft Handled	27.9	32.7	38.2	43.5	47.8	71.3
ACF Approach Control Operations**	----	----	----	----	61.0	----
FSS Service (millions)	62.4	52.9	44.2	46.4	48.2	(22.8)
Hours Flown (millions)						
Air Carrier	6.1	7.4	10.6	12.0	13.4	119.7
General Aviation	37.7	36.2	34.4	36.7	38.6	2.4
Military	6.2	5.9	6.0	7.0	7.0	12.9
Domestic Enplanements (Revenue Passenger) (millions)						
Air Carrier	272.8	350.4	447.8	570.4	695.8	155.1
Commuter	17.8	24.4	35.4	49.6	65.6	268.5
Aircraft Fleet (thousands)						
Air Carrier	2.5	2.9	4.1	4.4	4.8	92.0
Commuter***	1.4	1.5	1.8	2.0	2.1	50.0
Total General Aviation	213.3	220.9	216.7	217.8	221.1	3.7
Civil Helicopter***	7.0	7.1	7.1	8.7	10.3	47.1
Total Military	21.7	19.9	21.1	21.9	21.9	0.9
Military Helicopter***	9.7	7.3	8.9	9.2	9.2	(5.2)
Pilots (thousands)						
Instrument Rated	252.5	256.6	275.8	295.4	308.0	22.0
Total Pilots	764.2	722.4	715.8	756.8	787.8	3.1

* Aircraft operations forecasts are based on the existing airports included in the National Plan of Integrated Airport Systems (NPIAS).

** Approach control operations conducted for area control facilities equal the number of instrument operations conducted by towers.

*** Civil Helicopter and Commuter Fleets are included in the Total General Aviation Fleet. Military Helicopter Fleet is included in Total Military Fleet.

TABLE II. COMMERCIAL SERVICE AIRPORT ACTIVITY

	1982	1985	1990	1995	2000	Percent Growth 1982-2000
Large Hub Commercial Service*						
Airports	24	28	29	31	32	33.3
Operations (millions)	8.2	11.1	12.4	14.6	16.1	96.3
Enplanements** (millions)	196.3	280.3	352.3	453.0	538.8	174.5
Based Aircraft (thousands)	2.4	3.5	3.1	3.2	3.6	50.0
Other Commercial Service***						
Airports	521	518	534	537	556	6.7
Operations (millions)	53.8	40.0	48.7	57.5	66.5	23.6
Enplanements** (millions)	112.7	125.2	182.8	220.7	264.1	134.3
Based Aircraft (thousands)	61.0	60.3	57.8	58.3	60.4	(1.0)

* Airports at which over 1 percent of total U.S. passengers are enplaned.

** Includes scheduled and nonscheduled traffic by domestic and foreign flag carriers, commuters, and air taxis.

*** Airports receiving regularly scheduled service when 2,500 or more passengers are enplaned annually (excludes large hub commercial airports).

TABLE III. GENERAL AVIATION AIRPORT ACTIVITY

	1982	1985	1990	1995	2000	Percent Growth 1982-2000
Reliever Airports						
Airports	202	227	275	320	340	68.3
Operations (millions)	20.0	26.6	31.0	37.5	43.5	117.5
Based Aircraft (thousands)	44.3	55.5	63.6	74.0	78.6	77.4
General Aviation Airports						
Airports	2424	2440	2634	2712	2822	16.4
Operations (millions)	45.6	65.3	54.0	56.0	59.0	29.4
Based Aircraft (thousands)	67.9	79.4	84.4	73.8	69.3	2.1

TABLE IV. MILITARY AIRPORTS

	1982	1985	1990	1995	2000	Percent Growth 1982-2000
Airports	233	233	233	233	233	00.0
Operations (millions)	24.7	26.7	28.6	29.6	30.5	23.5
Military	21.7	23.1	24.3	24.9	25.5	17.5
Civil	3.0	3.5	4.3	4.5	4.6	53.3

AIRPORTS IN THE UNITED STATES

There are about 17,200 landing areas in the United States, of which over 5,700 are open to the public.

Currently the nation's most important civil airports are included in the National Plan of Integrated Airport Systems (NPIAS) prepared biannually by the Federal Aviation Administration, consistent with the Airport and Airway Improvement Act of 1982, as amended by the Airport and Airway Safety and Capacity Improvement Act of 1987. The plan includes the type and estimated costs of eligible airport development work in coordination with the National Airspace System Plan necessary to provide a safe, efficient system of public-use airports.

OPERATIONS

Today, civil airports handle about 143 million aircraft operations and enplane over 450 million passengers. They accommodate over 240,000 aircraft.

Airport development is largely the responsibility of state and local governments. The Federal Government participates in development at the request of state and local governments through its airport grant program and encourages airport planning and development to enhance safety, reduce congestion, and protect the environment.

Airport activity will increase substantially by the year 2000. Accommodating this additional demand will be more difficult in the future than it has been in the past. Although most of the nation's airports will have adequate airside capacity through the turn of the century, many of our key metropolitan areas are now congested and many more are expected to become congested before the turn of the century. In many metropolitan areas, there is little or no reserve capacity and the potential for airside expansion is limited. Though only a relatively small percentage of airports are involved, they handle a disproportionately high percentage of scheduled passengers. Today, the 28 largest commercial airports enplane approximately 68 percent of all passengers. In nonmetropolitan areas, needed capacity may usually be obtained through conventional construction of runways and associated taxiways.

The basic methods for adding airport capacity in congested areas are:

- High speed turnoffs.
- Short commuter runways.
- New or improved pavement at existing airports.
- Procedural changes such as reduction in longitudinal (in-trail) and lateral (e.g., separation between centerlines of parallel runways) separation standards.
- Terminal area flow optimization.
- New airports.

Some increases in airport capacity will result from FAA's broad efforts to modernize the National Airspace System which include improved techniques for metering and controlling traffic flow and the implementation of the microwave landing system. Further increases in capacity and reductions in delay may potentially be realized through the use of converging instrument approaches, development of short parallel runways for smaller aircraft, reduced spacing between runways for independent instrument flight rules (IFR) operations, and triple parallel instrument approaches.

Together with emphasis on safety, these measures will provide an important share, but not all, of the required increase in airport system capacity. Construction of new airports and new or improved pavements at existing airports provide the largest incremental gains to capacity. To the extent possible, FAA is encouraging use of airport planning and development grants for capacity-related projects at airports that are now congested or are expected to be congested within the next decade.

In some communities it will not be feasible to expand existing airports to accommodate forecast demand. Therefore, local and state governments must consider the construction of new major airports. The FAA will play an active role, as anticipated at Denver, in supporting such studies and providing local officials with appropriate aid to alleviate adverse environmental impact and overcome financial obstacles. There are major obstacles to new airport construction in metropolitan areas, but there are also substantial gains to be achieved when new procedures or airport improvements are made.

Establishing new major airports involves large financial, environmental, and land-use commitments. When the new proposed airports replace existing airports, large economic dislocations may result. It is for these reasons that metropolitan areas, when faced with overcrowded airports, seek alternatives to new construction. These alternatives can be broadly grouped as:

- Increasing the capacity and efficiency of existing airports through technical changes, scheduling changes and/or possibly peak pricing.
- Encouraging the use of aircraft with greater seating capacity.
- Increasing the use of existing secondary airports within the hub.

Further increases in the capacity of existing airports are possible through conventional construction (such as new runways) when feasible, incorporation of new and improved technology into the air traffic control system and related areas, and use of improved and innovative air traffic control procedures. Delays at individual airports may also be reduced by local authorities through spreading and/or meeting peak-hour traffic through regulatory or economic devices and encouraging the restructuring of airline service patterns so that connecting flights are not concentrated at a few large cities.

The second area for achieving increased capacity by employing large aircraft has been a key factor in accommodating growth for the past 20 years. The average seating capacity of large commercial aircraft has grown from less than 50 in 1950 to about 152 today. A significant part of projected passenger growth will continue to be absorbed through the use of larger aircraft. Adding more seats to existing aircraft and higher load factors will also contribute. Table II indicates that, at large airports, rate of passenger growth is about twice the growth of aircraft operations.

The severe aircraft delays experienced at certain major hub airports illustrate the need for increased airport capacity. Some increases in capacity can be achieved through greater use of secondary airports. To do this will require improving some reliever airports and constructing new ones, as well as more intensive use of existing second or third airports for scheduled service. The following chart depicts the number of airports that are presently congested through the turn of the century, if additional capacity is not provided through new construction or implementation of capacity-enhancing programs.

Alleviation of congestion through demand reduction by either economic or regulatory means is not reflected. Priority will be given to research and facilities projects which show promise of reducing congestion at airports. Priority will also be given under the airport grant program to projects which may alleviate congestion.

The Airport and Airway Improvement Act of 1982 as amended includes a restructured airport grant program which provides an expanded program focus on airport capacity enhancement as well as safety improvements. Through a significantly enlarged discretionary fund, incorporating a capacity set-aside, the grant program will provide more funds for projects which enhance system capacity. Airport noise and reliever airport projects which expand system capacity will also be eligible for these discretionary funds. While enhanced airport safety is the primary thrust of the annual airport grant program proposal, the emphasis on airport system capacity will allow gains in airspace capacity through implementation of the NAS Plan to be matched by gains in airport capacity.

FUTURE REQUIREMENTS

Facilities and equipment, both federally and locally provided, will be needed in response to increases in demand, the provision of new or improved services, and the growth in number of airports. Figures associated with the following maps illustrate the anticipated distribution of airports, facilities, and equipment in four time frames: 1981, 1985, 1990, 1995, and 2000. Figures are provided for each airport type (large hub commercial service, other commercial service, general aviation, and reliever).

The figures for each airport group show: (1) the growth in airport quantities and demographics and (2) the correlation of probability that particular services will be provided with respect to the various types of systems or equipment serving that type of airport. Airports that do not meet FAA benefit/cost criteria for approach guidance or air traffic control services may be provided facilities through non-federal sources. Additionally, airports which meet FAA benefit/cost criteria for air traffic control services may be more economically staffed through contract services.

SERVICES TO AIRPORTS

The following charts depict the congested airports; past, current, and future distribution of airports; and federal services provided, as well as those service expansions expected from the implementation of the programs described in the NAS Plan. Separate charts are included for each category as defined below.

Commercial Service Airport: A public airport which is determined by the Secretary to enplane annually 2,500 or more passengers and receive scheduled passenger service of aircraft. The commercial service airports are further categorized as Primary and Non-primary Commercial Service Airports (based on Airport and Airway Improvement Act of 1982, as amended).

- Primary Airport: A commercial service airport which is determined by the Secretary to have 10,000 or more passengers enplaned annually.
- Non-primary Commercial Service Airport: A commercial service airport which is determined by the Secretary to have between 2,500 and 9,999 passengers enplaned annually.

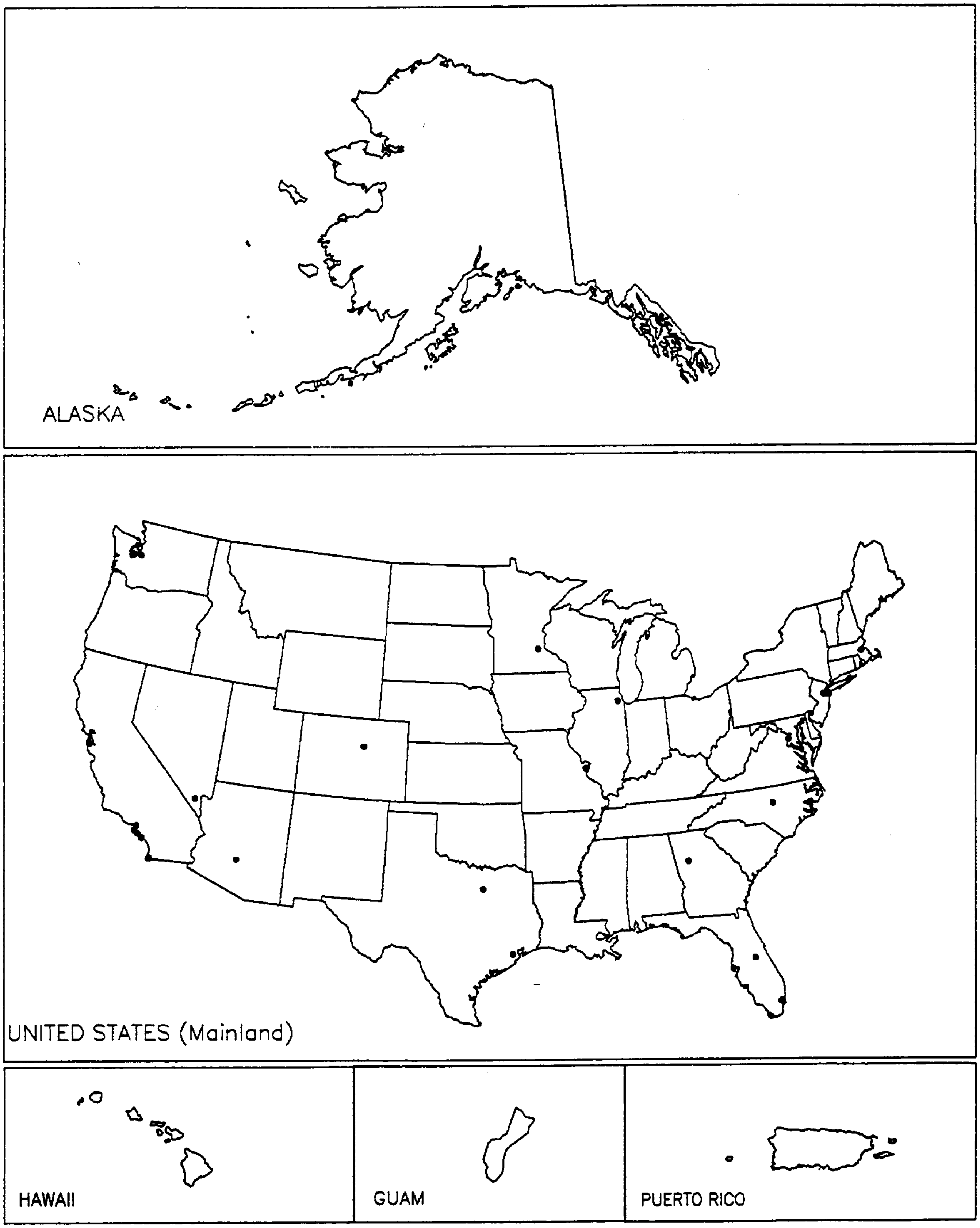
Reliever Airport: An airport including heliport, designated by the Secretary as meeting criteria developed by the Secretary, based on relieving current or forecast congestion at a commercial service airport and providing more general aviation access to the overall community.

General Aviation Airport: This airport classification is no longer defined as a separate category in the new legislation; however, for the purposes that it is used in this chapter, it is defined as all other airports listed in the NPIAS that are not designated as commercial service or reliever airports.

The Airport and Airway Improvement Act of 1982 as amended adds a requirement for a report on performance and conditions of the national system of airports.

AIRPORTS TO EXPERIENCE SIGNIFICANT CONGESTION

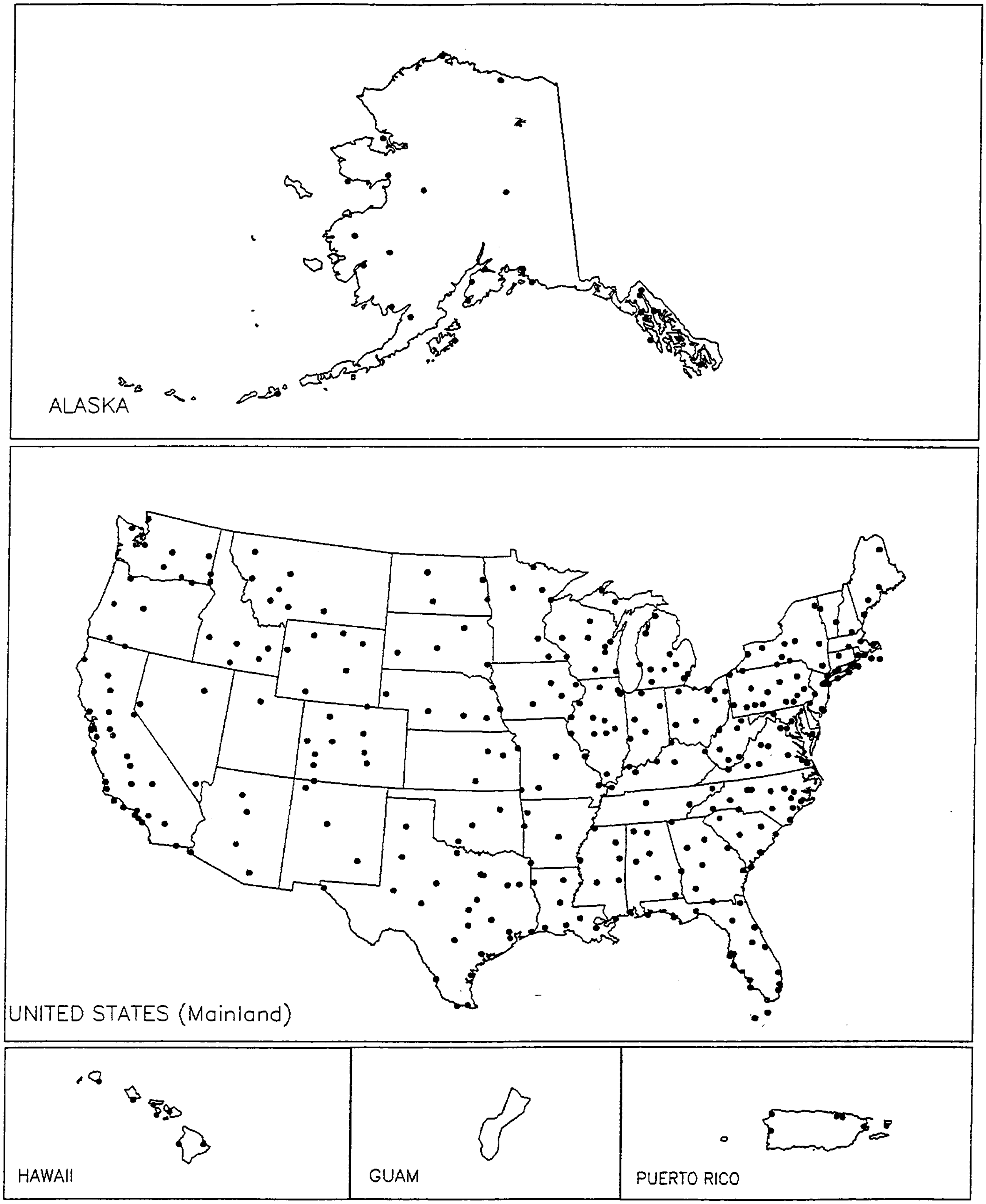
YEAR	COMMERCIAL SERVICE	GENERAL AVIATION	TOTAL
1981	10	4	14
1985	17	8	25
1990	25	21	46
2000	67	51	118



1990 CONGESTED COMMERCIAL SERVICE AIRPORTS

PRIMARY AIRPORTS							
YEAR	NUMBER OF AIRPORTS	NO FAA EQUIP	VISUAL AIDS ONLY	VISUAL AND PRECISION APPROACH AIDS	TOWER AND VISUAL AIDS	TOWER AND PRECISION APPROACH AIDS	TOWER RADAR SERVICE AND PRECISION APPROACH AIDS
1981	279	0	0	25	8	74	172
1985	274	0	0	24	9	61	180
1990 *	414	0	0	89	4	103	218
1995 *	416	0	0	89	4	103	220
2000 *	422	0	0	88	4	100	230

* Primary airports were redefined, resulting in a change of 134 airports from non-primary to primary in 1990 and subsequent years.

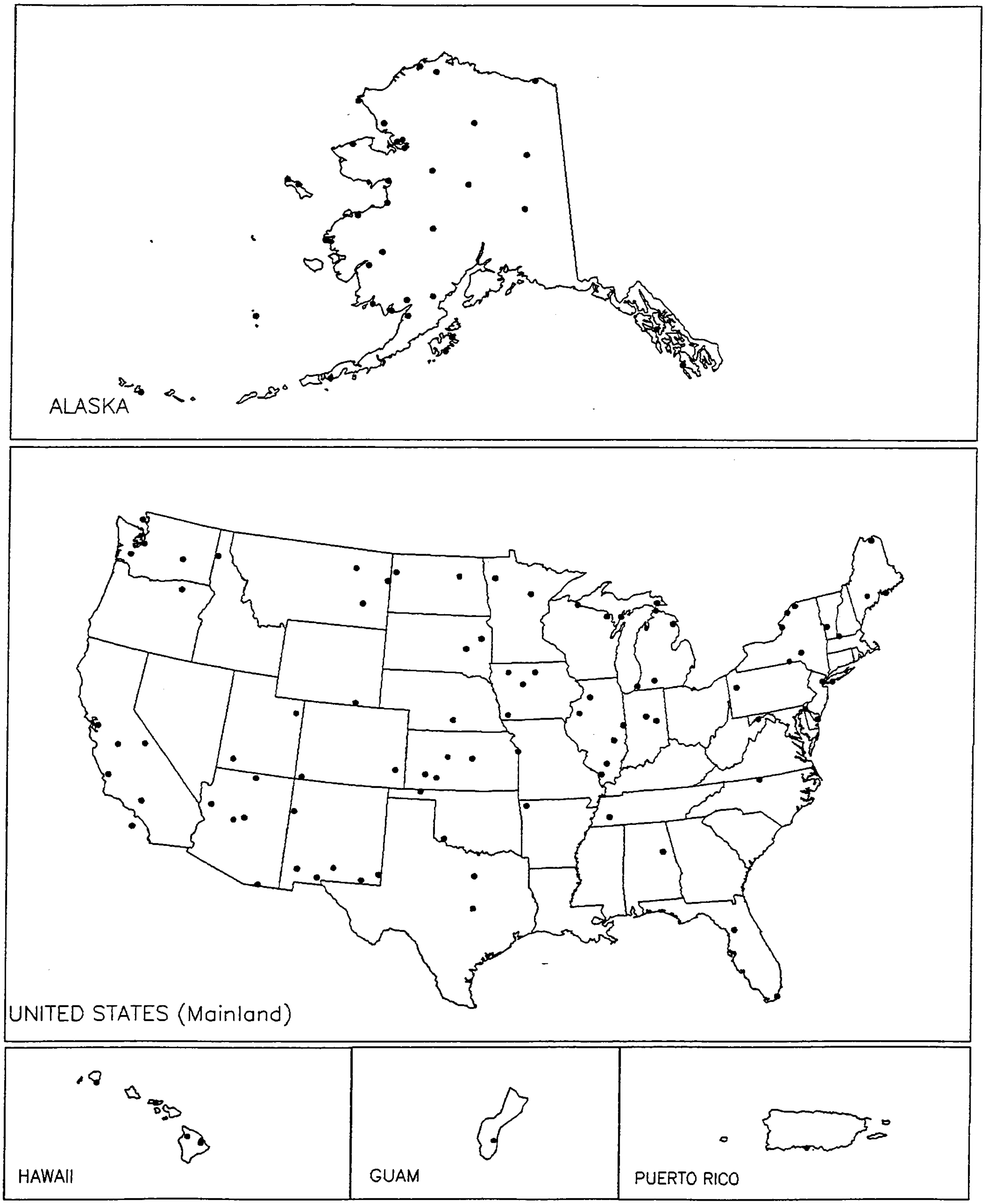


1990 PRIMARY AIRPORTS

NON-PRIMARY COMMERCIAL SERVICE AIRPORTS							
YEAR	NUMBER OF AIRPORTS	NO FAA EQUIP	VISUAL AIDS ONLY	VISUAL AND PRECISION APPROACH AIDS	TOWER AND VISUAL AIDS	TOWER AND PRECISION APPROACH AIDS	TOWER RADAR SERVICE AND PRECISION APPROACH AIDS
1981	493*	244	77	100	5	56	11
1985	272	57	43	107	5	49	11
1990 **	143	32	12	99	0	0	0
1995 **	151	21	15	115	0	0	0
2000 **	166	0	15	151	0	0	0

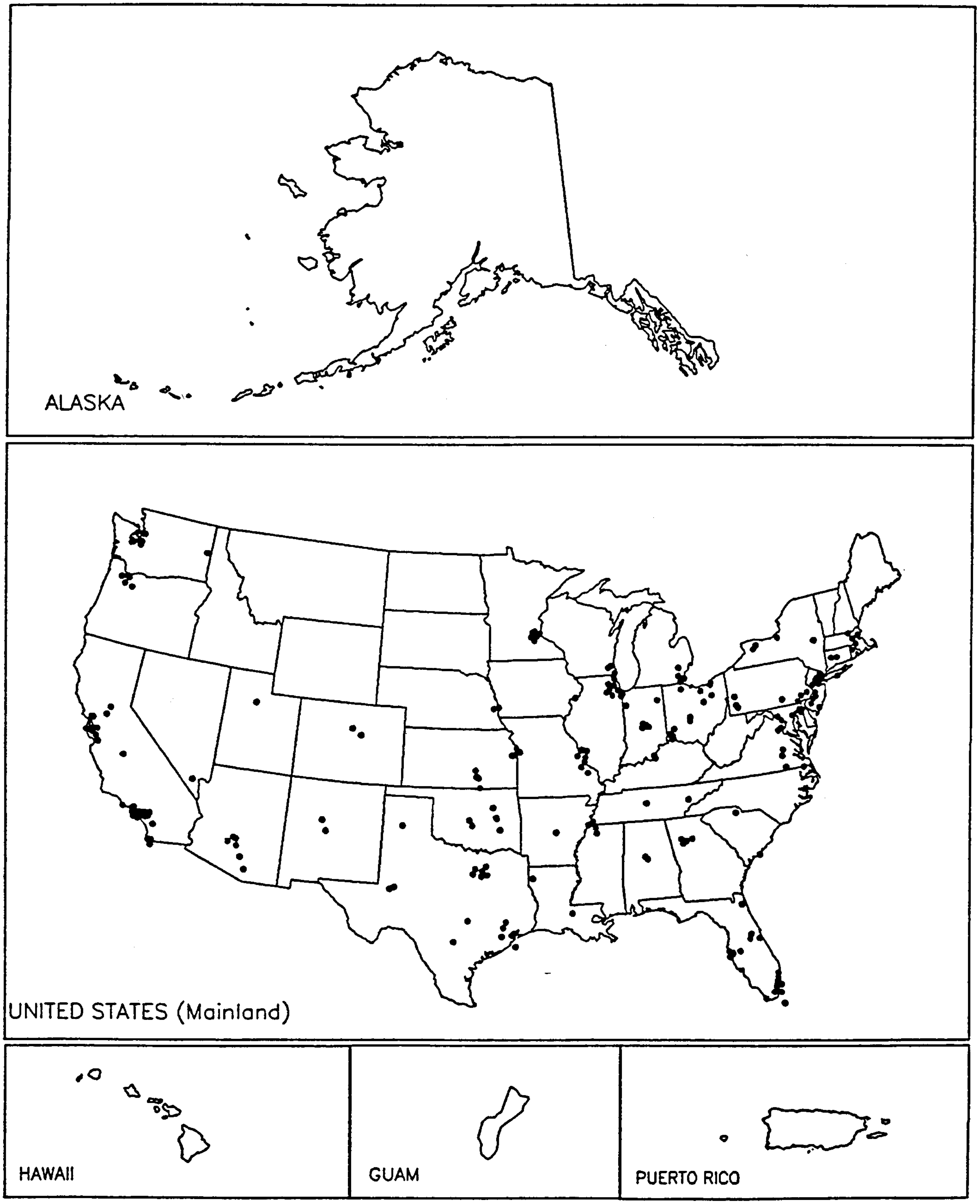
* Between 1981 and 1985, approximately 190 commercial airports were redefined as general aviation.

** Primary airports were redefined resulting in a change of 134 airports from non-primary to primary in 1990 and subsequent years.



1990 NON-PRIMARY COMMERCIAL SERVICE AIRPORTS

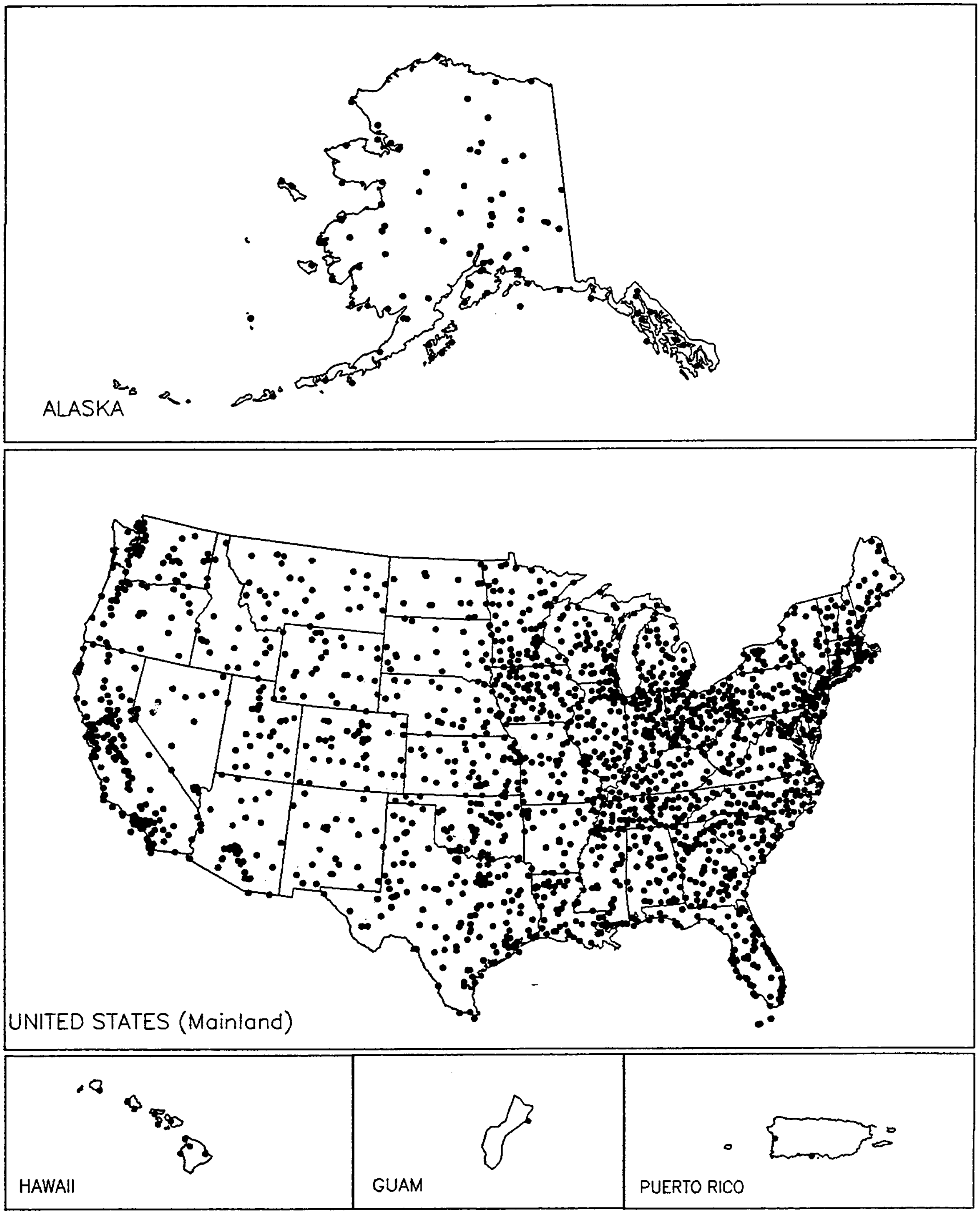
RELIEVER AIRPORTS							
YEAR	**NUMBER OF AIRPORTS**	**NO FAA EQUIP**	**VISUAL AIDS ONLY**	**VISUAL AND PRECISION APPROACH AIDS**	**TOWER AND VISUAL AIDS**	**TOWER AND PRECISION APPROACH AIDS**	**TOWER RADAR SERVICE AND PRECISION APPROACH AIDS**
1981	163	70	7	11	31	41	3
1985	227	100	17	24	25	20	41
1990	275	92	0	100	3	17	63
1995	320	86	31	120	3	18	62
2000	340	11	25	220	3	20	61



1990 RELIEVER AIRPORTS

GENERAL AVIATION AIRPORTS							
YEAR	NUMBER OF AIRPORTS	NO FAA EQUIP	VISUAL AIDS ONLY	VISUAI AND PRECISION APPROACH AIDS	TOWER AND VISUAL AIDS	TOWER AND PRECISION APPROACH AIDS	TOWER RADAR SERVICE AND PRECISION APPROACH AIDS
1981	2228*	2071	81	45	12	19	0
1985	2440	2195	148	67	8	17	5
1990	2634	2414	137	60	7	8	8
1995	2712	2425	186	80	5	10	6
2000	2822	2535	4	262	3	12	6

* Between 1981 and 1985, approximately 190 commercial airports were redefined as general aviation.



1990 GENERAL AVIATION AIRPORTS

AIRBORNE EQUIPMENT UTILIZATION

Projected utilization of airborne equipment in the next two decades is illustrated in Table V.

- Navigation. Use of VORTAC, a co-located very high frequency omnidirectional range (VOR) station and ultra high frequency tactical air navigation (TACAN) facility; area navigation, VOR with distance measuring equipment (DME); and, to a lesser extent, nondirectional beacons (NDB) are expected to continue through the end of the century. More advanced systems for 4-dimensional area navigation (RNAV) should become commonplace by the year 2000. The use of satellite navigation will increase, but still be too new to be in widespread use.

- Communication. Use of very high frequency (VHF) communications is anticipated to remain predominant throughout the period. By 2000, there will be widespread use of the Mode S transponder and data link system, VOR weather data broadcasts, and high frequency (HF) data link. Although not commonplace, satellite communications will be on the increase.

- Separation. The air traffic control radar beacon system (ATCRBS) transponders will be replaced by Mode S transponders. The traffic alert and collision avoidance system (TCAS) will provide airborne collision avoidance capability.

- Landing Systems. The microwave landing system (MLS) will replace the instrument landing system (ILS) where needed as the standard for precision approaches. Area navigation and Categories IIIA and B approaches are also expected to be in increasing use.

TABLE V. UTILIZATION

	1982	1985	1990	2000
NAVIGATION				
VOR/VORTAC	W	W	W	W
SATELLITE NAV (GPS)	N	N	N	L
DME	W	W	W	W
INS	L	I	I	W
LORAN C	L	I	I	W
NDB	W	W	W	W
RNAV	W	W	W	W
4D RNAV	L	I	I	W
COMMUNICATIONS & DATA LINK				
VHF COMM	W	W	W	W
UHF COMM	L	L	L	L
HF COMM	W	W	W	W
MODE S	N	N	N	W
ACARS	W	W	W	W
SATELLITE	N	N	L	I
VHF WX DATA BROADCAST	L	I	W	W
HF DATA LINK	L	L	L	W
AIRCRAFT SEPARATION				
TCAS III	N	N	L	I
TCAS II	N	N	L	I
TCAS I	N	N	L	W
ATCRBS	W	W	D	D
MODE S	N	N	L	W
LANDING SYSTEMS				
MLS	L	L	L	W
ILS	W	W	W	W
ADF	W	W	W	W
VOR	W	W	W	W
RNAV	L	L	I	W
CAT IIIA	L	L	I	I
CAT IIIB	L	L	L	L

Legend:

D - Decreasing Use
I - Increasing Use
L - Limited Use
N - Nonexistent
W - Widespread

CHAPTER III

ATC SYSTEMS

under the control of military or other facilities. The centers provide separation service, traffic advisories, and weather information to pilots while they are en route between airports. Terminal air traffic control facilities include airport traffic control towers (ATCT), terminal radar approach control (TRACON), and terminal radar approach control in the tower cab (TRACAB). Airport traffic control towers separate and sequence aircraft in the airspace immediately surrounding airports and on the airport's surface. Approach control facilities provide separation services to aircraft during the arrival and departure phases of flights in a larger amount of airspace surrounding airports. Flight service stations offer a wide range of services to the large general aviation public which would not otherwise be available. Services include flight plan filing and closing, preflight and in-flight weather briefings, en route communications with pilots flying under visual flight rules, and assistance to pilots in distress. This chapter describes in detail the specific improvements that must be made to en route, terminal, and flight service station facilities in order to meet the demands of air transportation between now and the year 2000 in a manner which will not only improve

nents will be as follows:

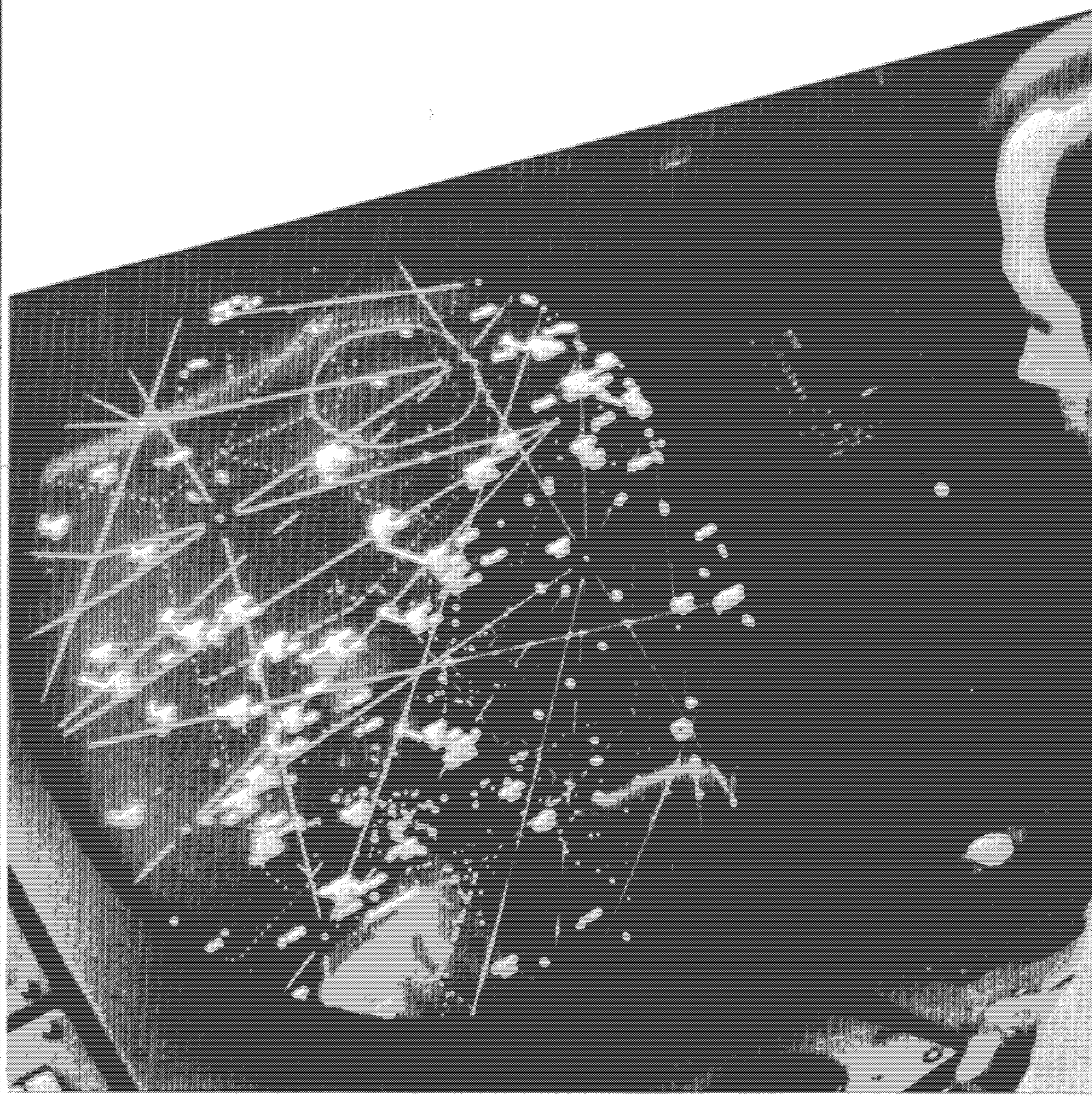
- En route systems computers will be replaced, more functions will be automated, communications will be modernized, traffic management will be improved, and all functions will become more highly integrated.

- Terminal systems will be upgraded and expanded, software will be enhanced, communications will be improved/integrated, and some functions will be consolidated.

- Flight service systems will be consolidated and automated, weather information will be more current and widely disseminated, and communications will be integrated with other elements of the system.

The air traffic control system that is evolving from this Plan will be totally integrated, will greatly improve safety and efficiency, become more responsive to user needs, and accommodate increasing demand while minimizing costs.

EN ROUTE



EN ROUTE SYSTEMS

Commercial airlines and other aircraft flying under instrument flight rules and not under the control of military or terminal facilities are monitored by air route traffic control centers. These centers control an aircraft's route of flight between airports. They provide separation services, traffic advisories, and weather advisories. Aircraft flying under visual flight rules are also monitored by these centers if they are in an area that has radar coverage. In addition, they assist aircraft in distress. The FAA en route system is, of course, an integral part of this country's national defense system.

Another integral part of the en route system is the Central Flow Control Facility. The Central Flow Control Computer Complex was upgraded and moved from Jacksonville, Florida, to the FAA Technical Center in FY 84. The central flow control operational facility is the ATC Command Center in Washington, D.C. Central flow control serves as a focal point for evaluating and approving traffic flow redistribution and nationwide management of air traffic flow. It also provides authority for initiating systemwide flow control. Central flow control, associated with the Airport Reservation Function (ARF), relieves congestion at the busiest airports. When associated with the Central Altitude Reservation Function (CARF), it supports military operations and provides coordination of other activities requiring airspace protection. In times of emergency or calamity affecting an air traffic control facility, it also serves as the contingency command post (CCP) for coordinating and supporting major realignments of control responsibilities.

A typical center is responsible for more than 100,000 square miles of airspace and hundreds of miles of airways in the sky, which are like electronic highways to pilots. A current center's geographic area is usually divided into 30 or more sectors with a team of controllers responsible for each sector.

At the outset of the NAS Plan, there were 20 air route traffic control centers in the continental United States. There were four offshore centers located at Anchorage, Honolulu, San Juan, and Guam. The San Juan and Guam Centers were combined center radar approach controls (CERAP).

The air traffic control system determined correct aircraft separation based on radar data input. Flight data was displayed on paper strips torn from flight strip printers. Very high frequency (VHF) and ultra high frequency (UHF) radios were used to provide pilots with traffic advisories and route clearances.

Twenty en route centers used 9020 computers developed in the 1960s to process radar and flight data. Three offshore control centers used en route automated radar tracking system (EARTS) computers and one CERAP used a TPX-42 beacon system to perform similar, but more limited, radar processing. Despite their capabilities, the 9020 computer systems were inadequate for handling the growth in aviation traffic beyond the late 1980s.

The en route center system was labor intensive. A great deal of manual effort and input was required of air traffic controllers. There were high hardware and software maintenance costs associated with its operation. Moreover, equipment manufacturers could not provide parts indefinitely regardless of cost.

Higher levels of automation were being developed to reduce operational costs, improve safety, and provide fuel savings for aircraft users. Implementation of these enhancements was not possible because of capacity limits.

THE NEW APPROACH

The FAA's current en route modernization programs are aimed at replacing existing air traffic control computer systems with modern technology. New software will be implemented to enhance safety and increase productivity and permit the integration of a number of functions now performed separately. While somewhat costly, this program will provide for and accommodate future enhancements which best meet the FAA's objectives and, at the same time, greatly benefit the users of the National Airspace System (NAS).

The new computer system is being designed for approximately 100 percent functional availability and reliability of services. Moreover, the new computers, software programs, and displays now being developed will be capable of providing both en route and terminal services. This will enable the agency to consolidate and reduce the number of facilities needed. Airport traffic control towers will still provide airport services; however, significant savings in manpower, rents, utilities, and energy costs will be realized. Use of the same system for en route and terminal functions will also eliminate or considerably diminish the present, somewhat arbitrary, demarcation of services and, thereby, reduce operational overhead. Consolidation of TRACONs into area control facilities (ACF) will begin in the mid-1990s.

The new air traffic control computers will provide more reliable, safer services to the user; accommodate safety enhancements as they are developed; and enable the agency to reduce manpower, training, and logistics costs. Implementation of the automated en route air traffic control (AERA) functions will further enhance safety, controller productivity, and fuel savings for the users.

The first step towards modernization is the replacement of the 9020 central computer complex with a host computer. (A host computer is a replacement computer which uses existing software from another computer system.) This host computer is running the present 9020 software package with minimal modifications. This provides immediate relief from current capacity restrictions and provides for projected air traffic growth until the advanced automation system is in place. The first host computer became operational at the Seattle ARTCC in mid-1987. The final host computer system became operational in June 1988.

In August, 1984, competitive contracts were awarded to two companies for the design of new advanced automation systems (AAS), including sector suites with distributed processing computers. These contracts provide for the design of replacement software programs partitioned to run in centralized computers and sector suites. In June, 1988, a critical design review (CDR) was conducted by both competing contractors. In July, 1988, the AAS acquisition phase contract was awarded. Operations requiring centralized processing will be accomplished in the centralized computers with all remaining functions performed within the individual sector suites. The designed reduced capability and emergency modes of AAS operation and sector suite processing capability will ensure that surveillance, flight, and weather data are provided with near 100 percent functional reliability. The acquisition approach minimizes the adverse impact of a major technical and operational transition. Additional safety and productivity functions will be included in the new software.

A typical sector suite will consist of displays which present a plan view of the current situation such as: (1) position of aircraft, and real-time weather; (2) electronic display of flight data (eliminating the need for the manual flight strip processing); and (3) the display of planning information and advanced functions such as AERA.

The voice switching and control system will provide automatic switching of communications. This capability will allow resectoring to meet demands. Leased-line and equipment costs will be reduced and permit eventual integration of voice and data communications. This will further reduce transmission costs.

The capability of the system to support both en route and terminal functions allows for consolidation into area control facilities. Standardization, flexibility, and expandability of the system's design will allow universal application, reduction of total operation costs, and facilitate accommodations of future requirements and enhancements.

The agency will enhance its flow control capabilities to provide more coverage and prediction features for the NAS. The long-range goal will be to couple this traffic management capability with area control facilities for total national flow management.

In summary, the FAA's present en route plans are designed to evolve current air traffic control systems into integrated systems designed to meet future needs for greater capacity and reliability. With higher levels of automation, present en route plans will improve both safety and productivity. The new system will be capable of providing both en route and terminal services, thereby enabling the agency to consolidate and reduce the total number of facilities needed to do the job.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Development of the integrated advanced air traffic control system has begun. Development of interim capabilities and systems required to smooth the transition to the more highly automated system is nearing completion. Implementation of improvements required to ensure the continued safe and reliable operation of the system in today's environment is well underway.

In mid-1984, contracts were awarded for the dual design competition phase of the advanced automation system (AAS) project. Development of ergonomic sector suites for area control facilities and airport traffic control towers and advanced computer processing capability began during this phase.

Development efforts of automated en route air traffic control (AERA) functions (performed by the AAS) are continuing. The system performance specification for AERA 1 was completed in 1984. AERA 2 concepts have been defined and will be validated in later phases of the program.

New voice communications switching capabilities are needed which complement the radar and flight data processing performed by the AAS to maximize controller productivity in ACFs. The specifications for VSCS prototype development have been completed.

Systems and capabilities are needed to provide processing capacity, improve safety, and improve operational efficiency throughout the transition period. The FAA has developed a replacement for its 9020 computers. A new host computer capable of running slightly modified 9020 software programs will provide the additional capacity needed to handle the growth in air traffic expected in the 1980s and improve system availability. Testing of competing host computers was completed and an acquisition contract was awarded in July 1985. Prototype software enhancements which improve safety or efficiency (en route metering, conflict resolution advisory, and conflict alert instrument flight rules/visual flight rules (IFR/VFR) Mode C Intruder) have been developed. Testing of these functions is continuing. Implementation of these functions requires the added computing capacity of host computers.

Enhancements are also being provided for EARTS locations. A contract has been awarded which provides radar data mosaicking and conflict alert/ minimum safe altitude warning.

Automated assistance for oceanic ATC is also being developed. A contract has been awarded for oceanic display and planning systems which will allow controllers to assign fuel-efficient routes and altitudes.

Also, during this period the agency began to improve and expand the automated interfaces between en route and terminal facilities. New flight data equipment was installed and tested at the Technical Center. The capability of the backup direct access radar channel (DARC) is being expanded through a contract awarded in 1982 to provide radar tracking, automatic track initiation, mosaicking, full data information tags and individual display switching. This eliminates the need to use plastic markers (shrimp boats), adjust displays to a horizontal position, and switch six displays at one time to the backup channel as was the case. A contract has been awarded for additional software improvements, which provide two way communications with the prime channel computer.

The 9020 central flow control complex has been replaced with an IBM 4341 computer with improved software. Traffic management units within the centers are being automated and the operational work stations at the ATC Command Center upgraded. The manual Central Altitude Reservation Function (CARF) and Airport Reservation Function (ARF) will also be automated at that time.

The project to replace cables, printed circuit boards, and medium-speed printers associated with the 9020 system has been completed.

Progress on these initial efforts has enabled the air traffic control system to handle the growth in traffic that has occurred during this period.

NEAR TERM (TO 1990)

During this period, the remaining 9020s will be replaced by host computers. New flight data equipment will be installed at centers and TRACONs to improve flight data transfers. Software enhancements improving system safety and fuel efficiency will be implemented. Enhanced safety levels will result through the implementation of IFR/VFR conflict alert and conflict resolution advisory software on the host computers. The implementation of new en route metering capabilities will further reduce delays and allow for optimized fuel-descent profiles. The conflict alert IFR/VFR Mode C intruder function has been implemented at all en route facilities .

To further expedite the movement of traffic, 15 nonradar control facilities have been integrated into existing radar facilities.

Two VSCS prototype system contracts were awarded in early FY 87. A VSCS production contract that will meet the stringent requirements of an ATC voice communications system and, at the same time reduce lease service costs, will be awarded. AERA 2 functional specifications were completed in early FY 86. Laboratory research and development activities investigating performance and operational applications of AERA 2 will continue during this period. The AERA 3 concept was finalized in FY 88.

Several significant AAS activities occur during this phase, including completion of design competition, awarding of system acquisition contract and completion of critical design reviews.

The foundation for transition to full AAS will have been provided. This step will prepare the way for additional integration of terminal and en route functions within area control facilities and for higher levels of automation when the full AAS is implemented in the 1990s.

The Direct Access Radar Channel (DARC) enhancements that provide radar tracking, mosaicking and individual display switching will be implemented. Implementation of the two-way prime channel/E-DARC communication interface will begin. En Route Automated Radar Tracking System (EARTS) radar data mosaicking and Conflict Alert/Minimum Safe Altitude Warning (CA/MSAW) enhancements that will further improve safety and increase capacity will be completed. System improvements provided by Oceanic Display and Planning System (ODAPS), and the replacement of flight data entry and printout devices will become operational and reduce FAA and user costs. An offshore flight data processing system (OFDPS), consisting of modern data processing equipment and associated adapted software, will be procured and installed in the Honolulu ARTCC. These activities will result in real time data processing, improved system reliability, and increased system capacity.

Construction, rehabilitation, and plant modernization of ARTCCs and ACFs will provide for heating and air conditioning replacements, upgraded electrical systems, compliance with Occupational Safety and Health Administration (OSHA) regulations, energy conservation, and improvements to security and roads.

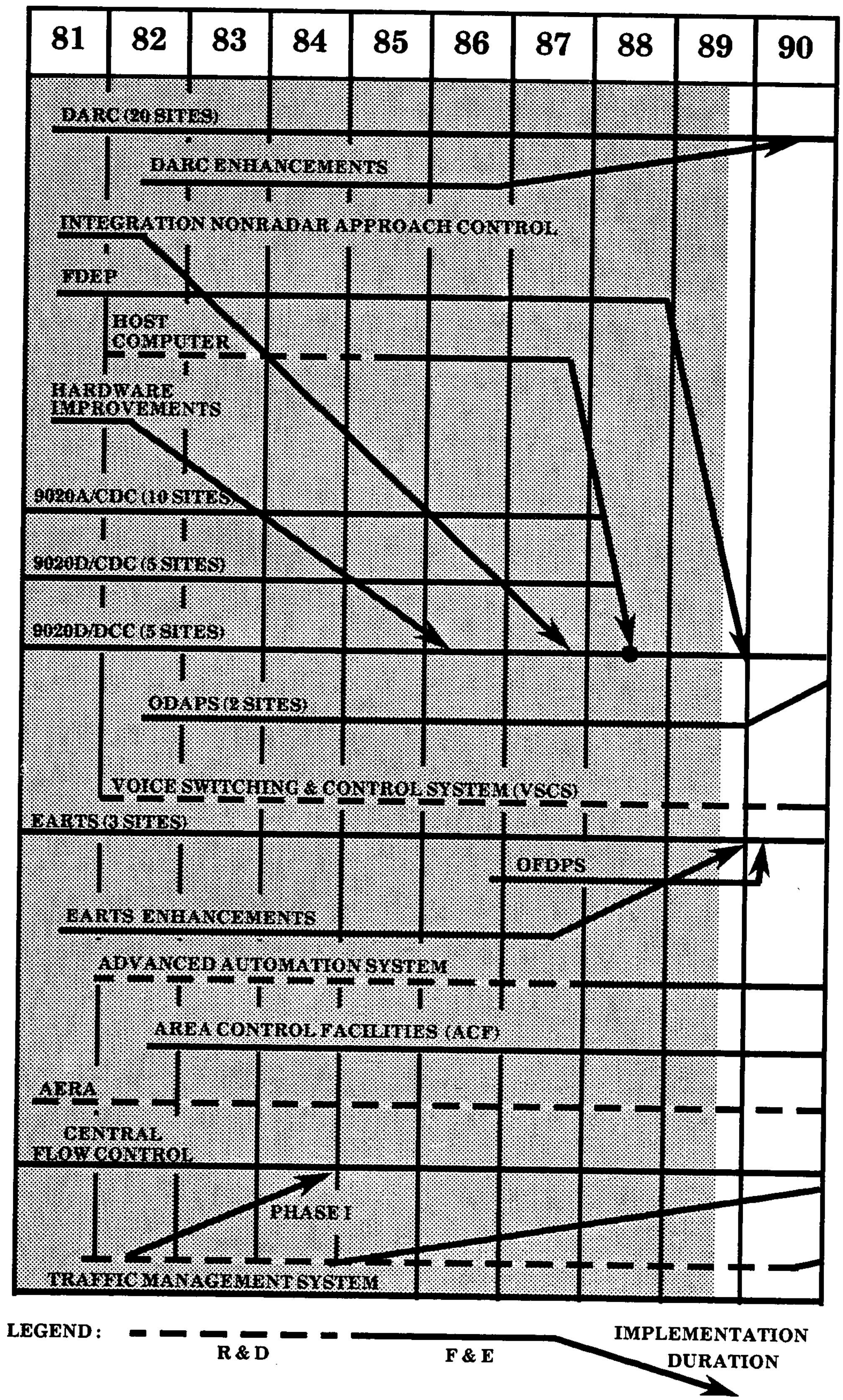
The capabilities of central flow control will be upgraded. Newly installed hardware and software will enhance the ability to project and estimate NAS traffic congestion and delay levels; provide this information to users; and evaluate alternate flow management strategies based on: arrival/departure messages, capacity estimates from major terminals, data input from the flight service data processing system (FSDPS) on VFR flight plans, and input from the aviation weather processor (AWP) for national weather information.

A foundation for greater Government and user efficiency will be provided. The future capabilities enabled by the advanced automation system will allow the expanded use of area navigation, rapid dissemination of control information, improved flight planning, and oceanic probes.

LONG TERM (TO 2000)

By the year 2000, a system wide advanced automated en route air traffic control system will be operational and the consolidation of TRACONs into area control facilities will have begun. The initial sector suite functional capabilities, coupled with the VSCS, will improve controller productivity and reduce lease service costs. Installation of the advanced automation system computers will provide the foundation to perform TRACON operations from ACFs. Implementation of the area control computer complex (ACCC) function will set the stage for the operational usage of automated en route air traffic control and Mode S ATC data link communications. Tower control computer complexes will be installed and the area control facility concept will become a reality. Also during this period, an advanced TMS, which will perform all national level traffic management functions, will be integrated with the AAS. This fully integrated system will improve traffic efficiency, minimize delays and be more responsive to user requirements.

Services provided by this country's future air traffic control system will be significantly better and more cost-effective. System reliability will be much higher. The increased use of automation will significantly improve both safety and efficiency. Introduction of more advanced automation functions into the system will result in even greater fuel savings.


81
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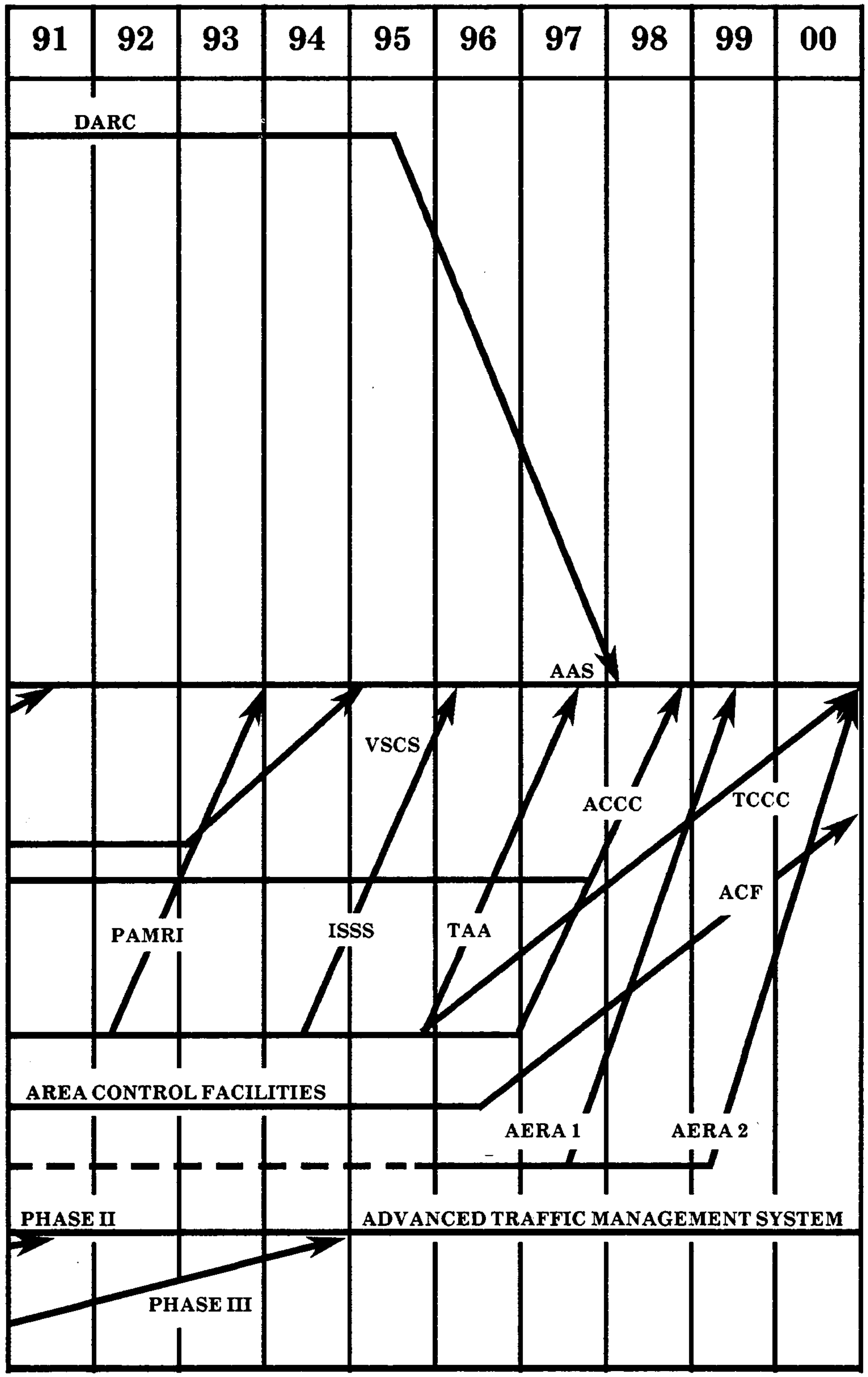
DARC (20 SITES)
DARC ENHANCEMENTS
INTEGRATION NONRADAR APPROACH CONTROL
FDEP
HOST COMPUTER
HARDWARE IMPROVEMENTS
9020A/CDC (10 SITES)
9020D/CDC (5 SITES)
9020D/DCC (5 SITES)
ODAPS (2 SITES)
VOICE SWITCHING & CONTROL SYSTEM (VSCS)
EARTS (3 SITES)
OFDPS
EARTS ENHANCEMENTS
ADVANCED AUTOMATION SYSTEM
AREA CONTROL FACILITIES (ACF)
AERA
CENTRAL FLOW CONTROL
PHASE I
TRAFFIC MANAGEMENT SYSTEM
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION

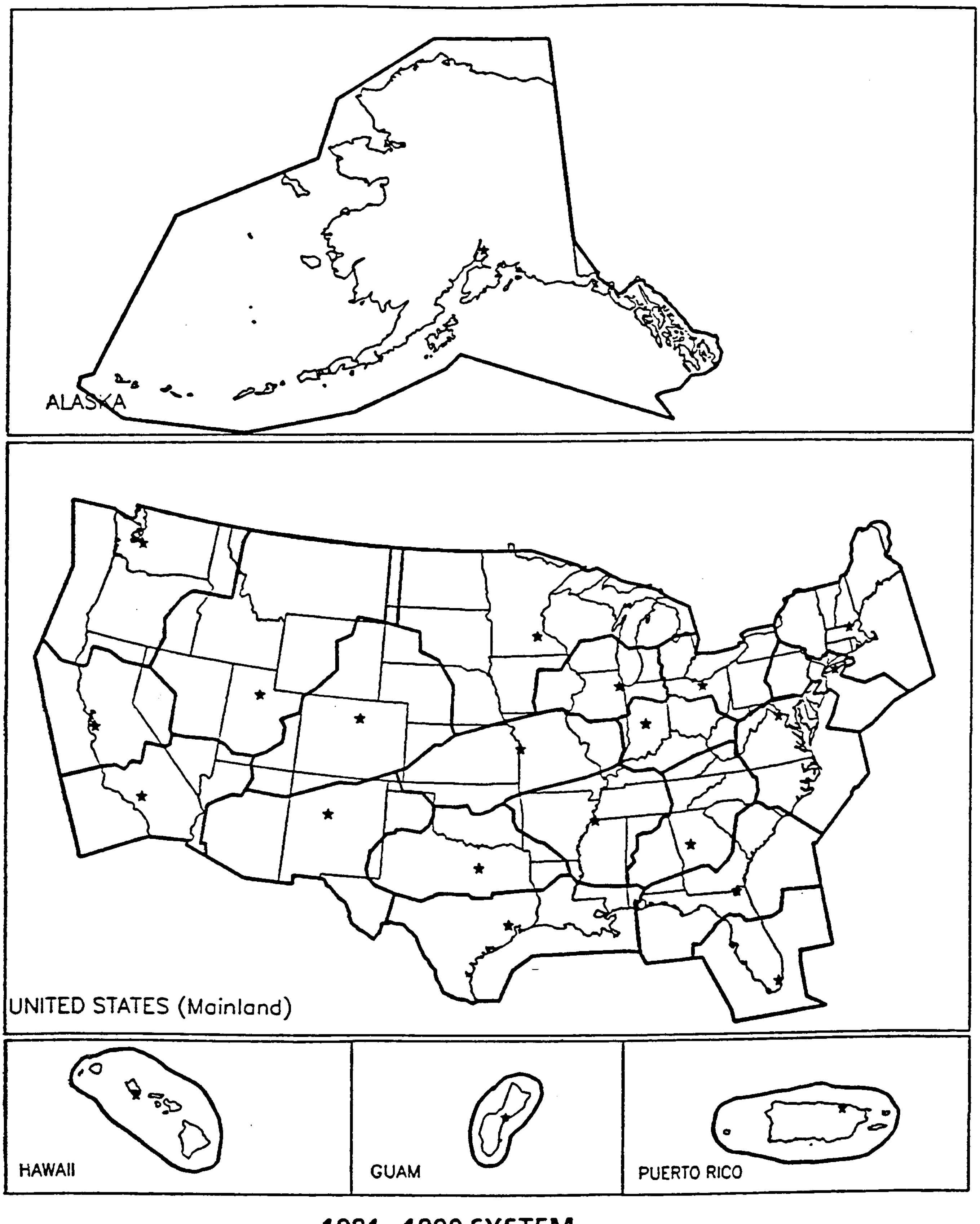


EN ROUTE SYSTEMS EVOLUTION

IN 1981, 20 CONTIGUOUS UNITED STATES (CONUS) AIR ROUTE TRAFFIC CONTROL CENTERS AND FIVE OFFSHORE CENTERS SUPPORTED U.S. DOMESTIC AIRSPACE. IN THE SPRING OF 1983 THE PANAMA CERAP WAS TURNED OVER TO THE PANAMANIAN GOVERNMENT. TODAY, THERE ARE 20 CONUS CENTERS, AND CENTERS LOCATED IN ALASKA, HAWAII, PUERTO RICO, AND GUAM.

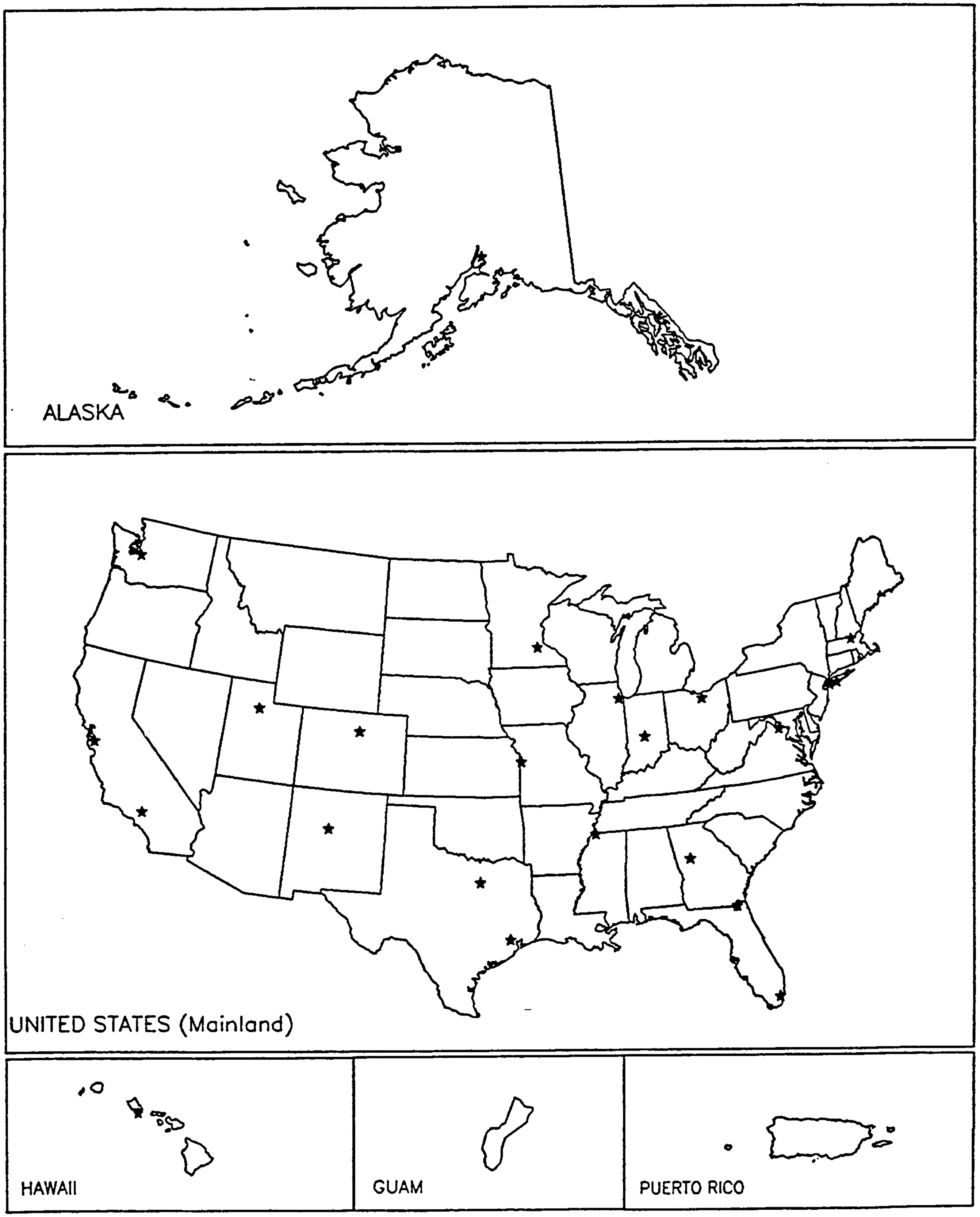
FLIGHT ADVISORY AREAS

★ AIR ROUTE TRAFFIC CONTROL CENTERS (ARTCC)



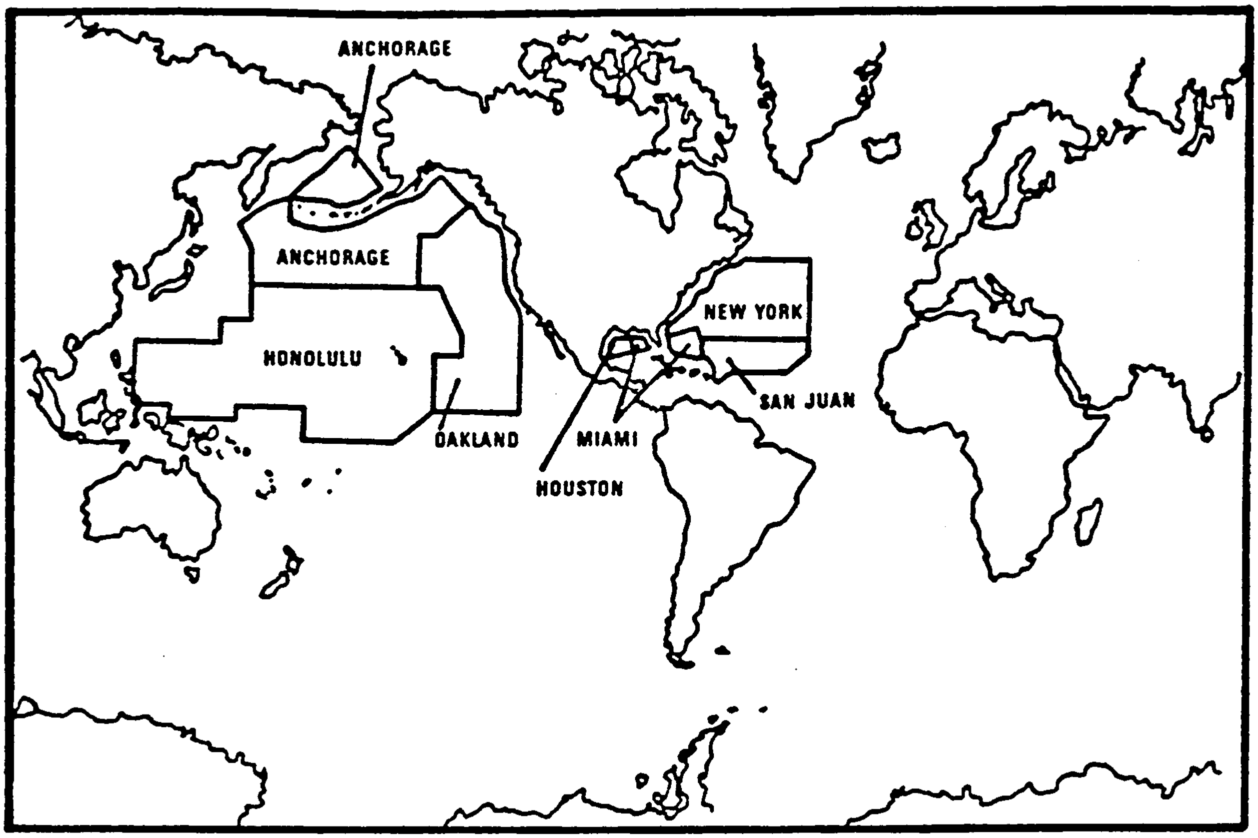
1981 - 1990 SYSTEM
ARTCC AND FLIGHT ADVISORY AREA

BY THE YEAR 2000, AREA CONTROL FACILITIES WILL SUPPORT EN ROUTE AND TERMINAL FUNCTIONS. ACTUAL LOCATIONS AND DATES MAY CHANGE AS PLANS CONTINUE TO DEVELOP.



2000 SYSTEM
AREA CONTROL FACILITIES

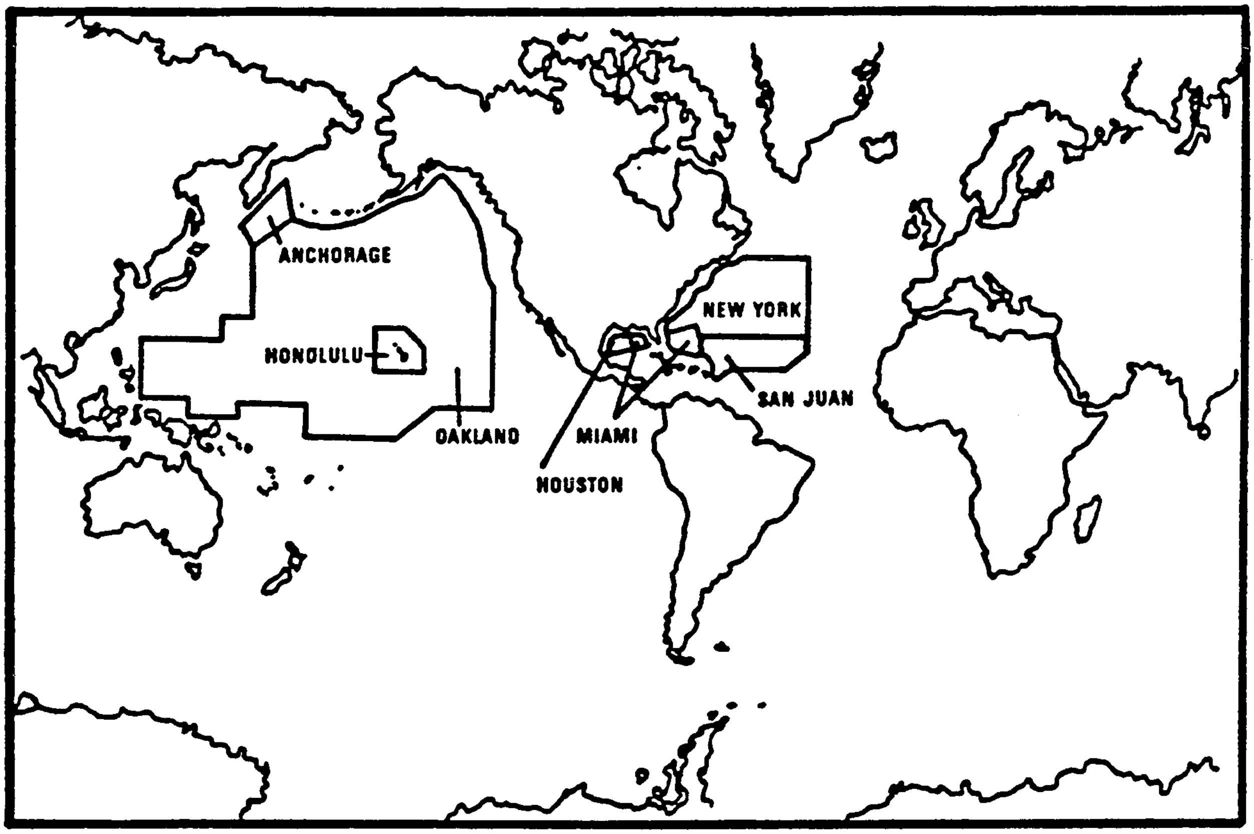
BETWEEN 1981 AND 1984, SEVEN AIR ROUTE TRAFFIC CONTROL CENTERS SUPPORTED OCEANIC FLIGHT IN U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS.



SEVEN CENTERS SUPPORTING U.S. CONTROLLED
INTERNATIONAL FLIGHT INFORMATION REGIONS

1981 - 1984 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

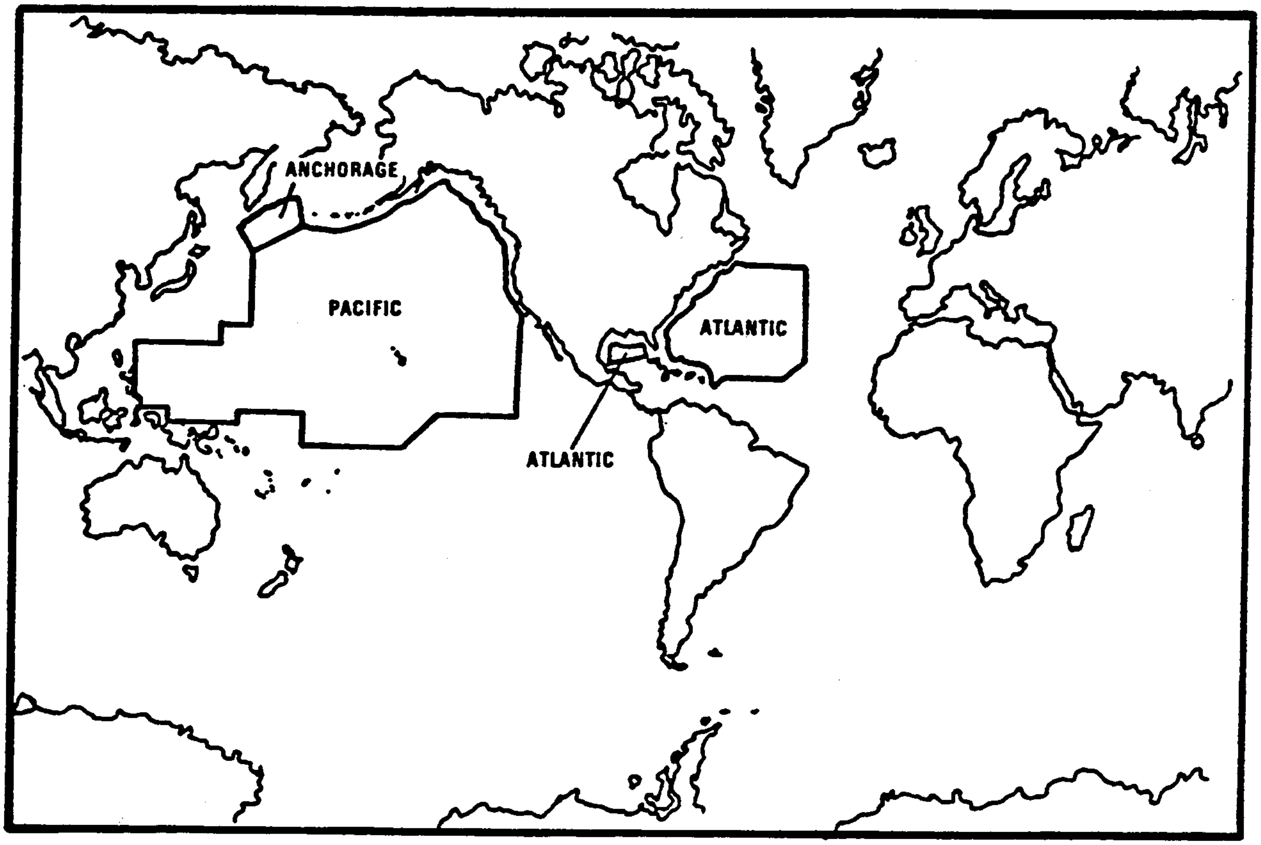
IN 1985, THE GEOGRAPHIC AREA CONTROLLED BY EACH OF THE SEVEN ARTCCs WAS REALIGNED TO MAXIMIZE PRODUCTIVITY AND TO PROVIDE FOR IMPLEMENTATION OF THE OCEANIC DISPLAY AND PLANNING SYSTEM.



SEVEN CENTERS SUPPORTING U.S. CONTROLLED
INTERNATIONAL FLIGHT INFORMATION REGIONS

1985 - 1986 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

DURING THE PERIOD 1987-2000, THREE AIR ROUTE TRAFFIC CONTROL CENTERS WILL SUPPORT U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS. OCEANIC DISPLAY AND PLANNING SYSTEMS (ODAPS) FOR ATLANTIC AND PACIFIC OPERATIONS WILL BE DEPLOYED PRIOR TO THE INTRODUCTION OF AAS.



THREE CENTERS SUPPORTING U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS

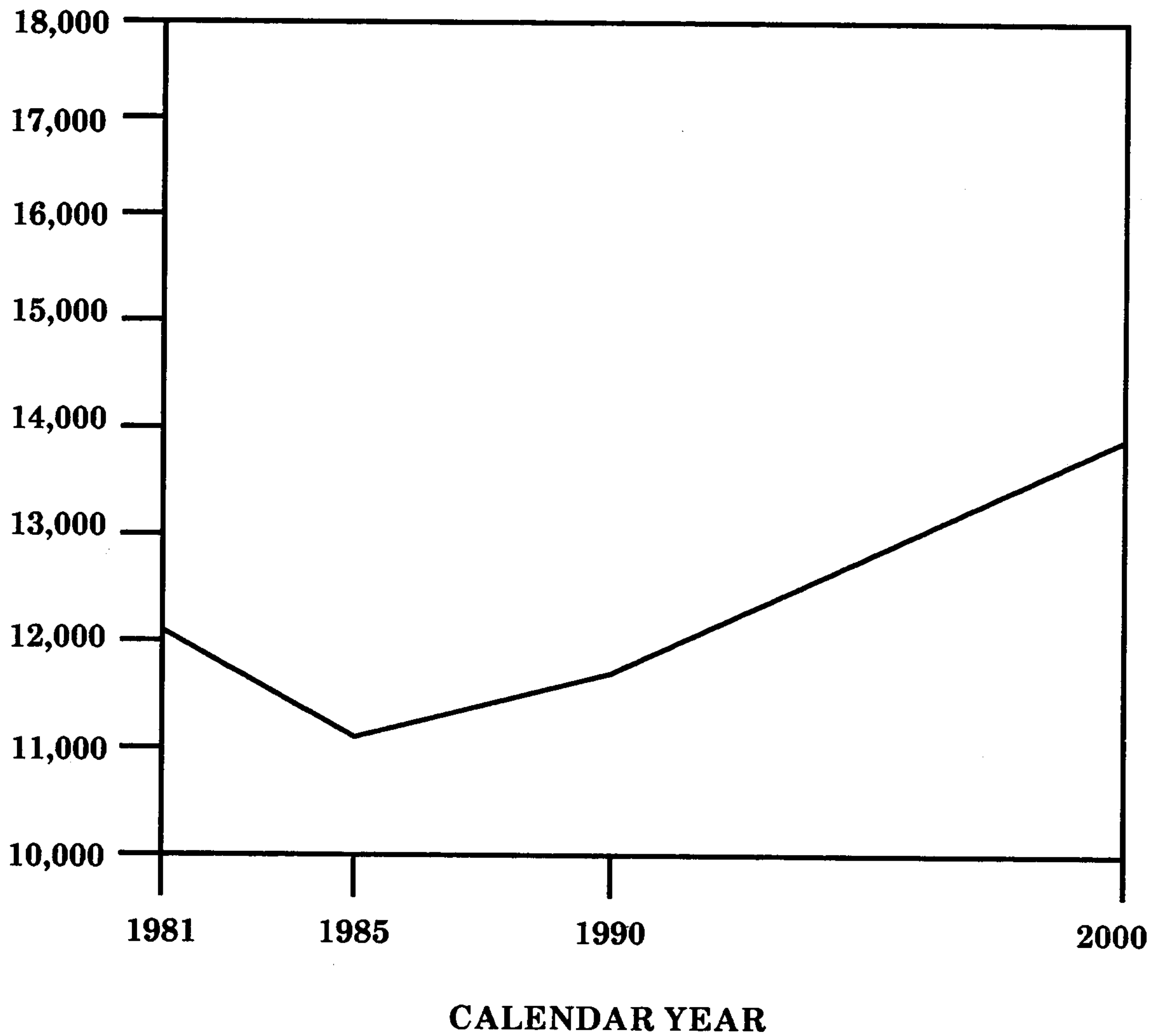
1987 - 2000 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

RETURN ON THE INVESTMENT

As a result of these planned actions, an upgraded air traffic control system will have been implemented. This will serve as the basis for significant improvements in air safety and will provide the reliability and flexibility necessary for further automation. These system improvements will allow for reductions in maintenance staffing and a slower growth in the number of air traffic controllers than would otherwise occur.

FIELD EMPLOYMENT

During the next 11 years, the en route system will undergo numerous changes in hardware, software, and plant improvements. These changes will affect both Air Traffic and Airway Facilities employment as shown in the chart below:



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(EN ROUTE/ACF SYSTEMS)

SUMMARY OF FACILITY CHANGES

1981–Airway Facilities (AF) and Air Traffic (AT) employment required a total of 12,124 people.

1985–Air Traffic employment decreased to 9,125 principally because of reductions made possible by enhancing the direct access radar channel (DARC) and resectoring en route airspace. A total AT and AF work force of 11,109 was required to operate and support facilities.

1990–Airway Facilities employment will decrease due to the replacement of the central computer complex and other equipment within the ARTCC.

2000–Air Traffic employment is estimated to increase to 12,273. This apparent increase, however, is offset by the decrease in employees previously required for terminal radar approach controls (TRACON) and other management initiatives. The total AT employment for en route and terminal facilities will actually decrease from 22,619 (in 1990) to 18,737 due to consolidation of terminal and enroute operations into area control facilities and the capabilities of advanced automation.

Outyear estimates are reviewed annually and are subject to revision.

EN ROUTE/ACF SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS
(1981 Dollars)

	1981	1985	1990	2000
Operations (Millions)	27.3	32.7	38.2	47.8
Air Traffic Personnel	10,300	9,125	10,360	12,273
AT Productivity Quotient	2,650	3,584	3,687	3,895
Airway Facilities Personnel	1,824	1,984	1,602	1,391
AF Productivity Quotient	14,967	16,482	23,845	34,364
Total AT & AF Staffing	12,124	11,109	11,962	13,664
Air Traffic Personnel Costs (Thousands)	$368,740	$326,675	$370,888	$439,373
Airway Facilities Personnel Costs (Thousands)	$62,198	$67,654	$54,628	$47,433

PROGRAM RELATIONSHIPS

The objective of the NAS Plan is the creation of a fully integrated air traffic control and navigation system capable of meeting the capacity, efficiency, and air safety demands anticipated by the turn of the century. Its projects are interrelated.

Implementation of the advanced automation system and area control facilities, described in this section of the Plan, will bring about major changes in the methodology and hardware used in the terminal environment. In the mid-1990s, the radar approach control facilities will begin to be consolidated into area control facilities supported by standardized equipment. New tower control computer complexes (the terminal component of the advanced automation system) will be installed in towers. The AAS will integrate en route and terminal air traffic control by providing full access to traffic, flight, and weather data bases available in ACFs.

The Flight Service and Weather Systems portion of the Plan contains improvements required to modernize flight and weather services which also affect en route system performance. Foremost among them, the central weather processor provides improved weather products for ACF operations. Moreover, guidance, surveillance, weather, and communications aids must receive upgrades and service improvements (as described in Chapter IV) to optimize system performance or provide the foundation for service improvement through the next decade.

Projects in Chapter V, Interfacility Communications Systems, improve the reliability, efficiency, and cost-effectiveness of communicating digital and voice information between towers, ACFs, and remote facilities. This chapter also implements television microwave links needed to provide radar data to satellite towers.

Chapter VI, Maintenance and Operations Support Systems, describes improvements to maintenance, flight inspection, and overall system support of the NAS.

The projects in this section form a unified 3-phase approach that has maintained reliable service, will improve services in the near term, and modernize service in the long term. Initial efforts included En Route Automation Hardware Improvements and Enhancements, and the first phase of the Traffic Management System; these resolved immediate problems, and allowed an evolutionary approach to service improvement. Near-term projects will provide for service improvements in continental, offshore, and oceanic airspace.

Individual but related improvements in continental services are derived from the implementation of modern ATC host computer and dependent software enhancements (en route metering, and conflict alert IFR/VFR Mode C intruder), flight data entry and printout devices replacement, enhanced DARC, and the second phase of traffic management system improvement. Improvement in offshore services is derived from EARTS enhancements and an offshore flight data processing system. Oceanic services are improved by ODAPS.

Modernization of the air traffic control system will occur with the establishment of area control facilities and the implementation of automated en route air traffic control (AERA). The capabilities of AAS and the voice switching and control system are required to establish ACFs and execute AERA functions. Enhanced DARC and the host computer are required to transition to the AAS.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
1. En Route Automation Hardware Improvements and Enhancements	PROJECT COMPLETE	1986
2. Flight Data Entry and Printout Devices	1988	1989
3. Direct Access Radar Channel (DARC) System	1986	1990
4. EARTS Enhancements	1987	1989
5. Oceanic Display and Planning System (ODAPS)	1989	1991
6. Traffic Management System (TMS)	1982	1994
7. Modern ATC Host Computer	PROJECT COMPLETE	1988
8. En Route Metering (ERM)	COMBINED	WITH TMS
9. Conflict Resolution Advisory (CRA) Function	1993	1993
10. Conflict Alert IFR/VFR Mode C Intruder	PROJECT COMPLETE	1988
11. Voice Switching and Control System (VSCS)	1993	1995
12. Advanced Automation System (AAS)	1992 *	2000
13. Automated En Route Air Traffic Control (AERA)	1997	2001
14. Integration of Nonradar Approach Control into Radar Facilities	PROJECT COMPLETE	1987
15. Area Control Facilities (ACF)	1996	2002
16. Offshore Flight Data Processing System (OFDPS)	1990	1990

* PAMRI

PROJECT SUMMARY

PROJECT 2: Flight Data Entry and Printout Devices

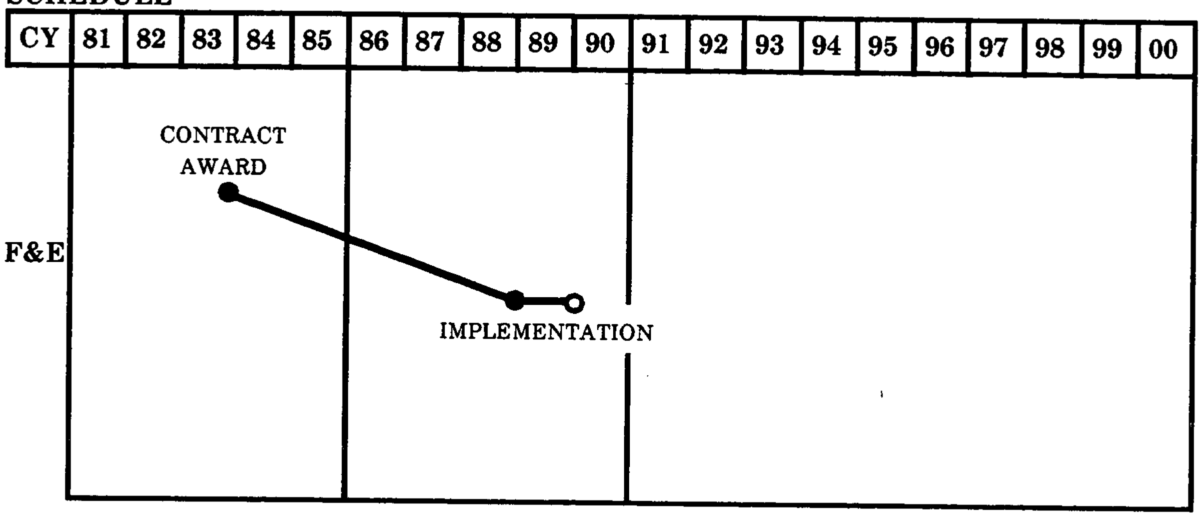
Purpose: The flight data input/output (FDIO) project will replace the existing flight data entry and printout (FDEP) and en route flight strip printer (FSP) systems and establish FDIOs at additional airport locations. Replacements will result in a reduction in manpower-intensive equipment and in a savings of up to $3 million a year. New establishments allow the automatic exchange of flight data with the air route traffic control centers over telephone lines. Automatic exchange is a vast improvement over manual exchange which is time-consuming, can cause delays to air traffic, and can create the potential for human error because the flight plan information is copied by hand. New establishments will result in a reduction in overall manpower (operators and technicians) costs up to $6 million a year.

Approach: A basic contract with multi-year delivery requirements has been awarded. Initial equipment deliveries began in 1986 and were completed in mid 1987. The FDIO program consists of ARTCC systems, systems for the FAA Academy and the FAA Technical Center, 318 remote systems, spare parts, documentation, engineering support services, implementation plans, and test procedures. Requirements for additional equipment components will necessitate future year procurements. A rewrite of a portion of the host software was necessary to utilize the general purpose output/general purpose input (GPO/GPI) adapters in lieu of the FDEP adapters currently used. The software is required to process data from both old and new systems simultaneously during FDIO implementation.

Products: This program includes the replacement of flight strip printers at: 23 ARTCCs, 318 ATCT/TRACONs, 108 military terminals, the FAA Academy and the FAA Technical Center and the establishment of new FDIO systems at each of these facilities. Additionally, FDIO systems will be utilized as integral components of ODAPS and OFDPS.

Related Projects/Activities: OFDPS, ODAPS and ATCT/ TRACON Relocation, Modernization, and Establishment all require the new FDIO devices. Modifications to host computer software is required for interface with the FDIO system. DOD interfaces and requirements are included in the FAA's contract. This project will require interfacility communications service from NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing.

SCHEDULE



PROJECT 3: Direct Access Radar Channel (DARC) System

Purpose: The current DARC system was in place in all 9020 ARTCCs in June 1981. The DARC enhancements upgrade the backup system to look and function in a similar manner to the prime channel computer. DARC enhancements provide tracking, mosaicking, and real-time quality control and will allow each controller to select either mode of operation, prime channel computer or DARC, at the radar console. The DARC enhancements improve the safe and orderly transition from prime channel operation. From the controllers' viewpoint, DARC enhancements eliminate the use of mechanical radar target markers and the need to move the plan view display (PVD) to the horizontal position.

Approach: The DARC system is being implemented in two phases. A contract for the first phase of the DARC system enhancements was awarded in early 1982 and provided for the development, production, documentation, installation, and test of three turnkey systems. The remaining systems were installed and tested by FAA personnel in FY 86 . The first system became operational at the Seattle ARTCC in late 1986.

The DARC enhancements include system analysis recorders for post air traffic incident review, doubling memory and processing power by adding plug compatible metal-oxide semiconductor memory and microcomputer boards. Added enhancements include tracking, automatic track initiation, mosaicking, and real time quality control. Modified display generator input/ output boards, cable harnesses for individual PVD switching capability, and fully automatic display processor and generator sparing were provided.

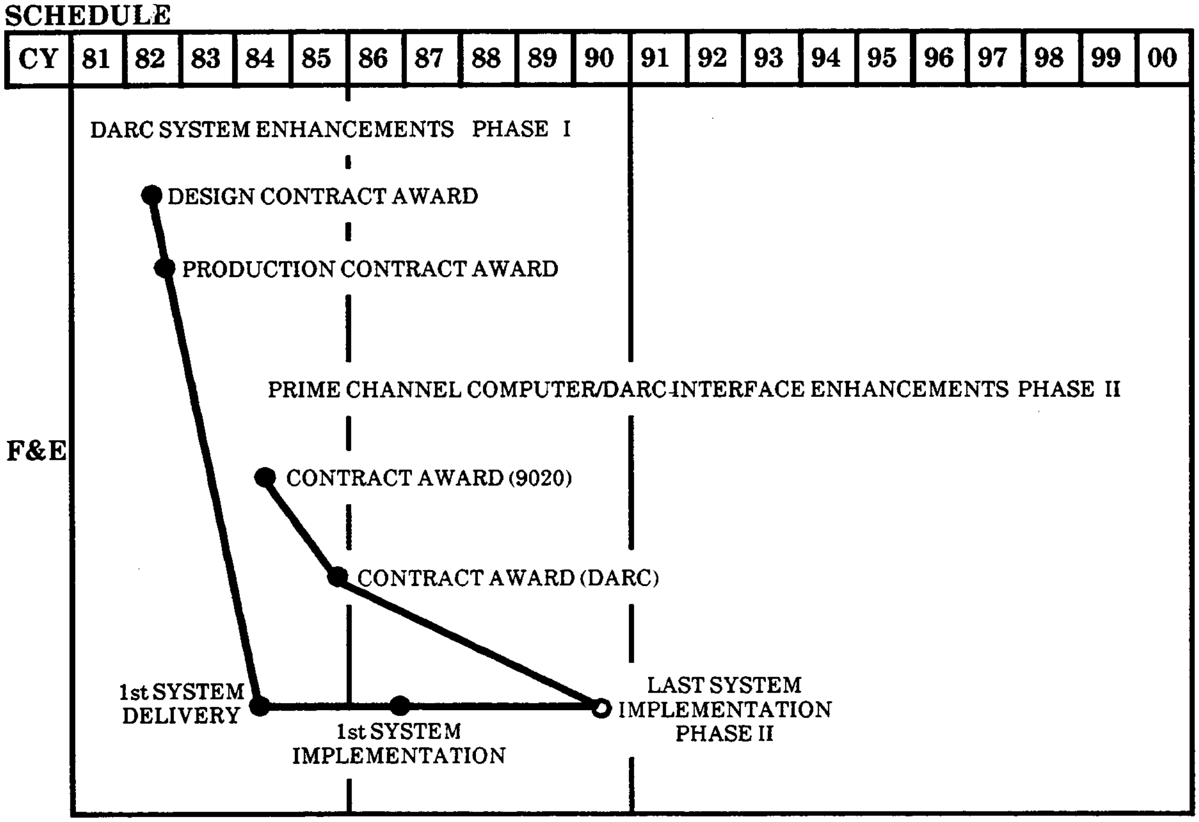
Software delivered and tested by the contractor at the FAA Technical Center and FAA Academy has been baselined and distributed to a selected ARTCC for key-site testing. Subsequent to key-site testing, software was delivered to the remaining ARTCCs in early 1987.

With the implementation of DARC Phase II, tracks will be automatically initiated using flight plan related data received from the prime channel computer via a communications interface between the prime channel computer and DARC. If the prime channel computer becomes non-operational, DARC will continue to track and display full data blocks. A contract for the prime channel computer software modifications was awarded in FY 84 and a similar contract for the DARC software modifications was awarded in early FY 86. The implementation of the prime channel computer modifications will allow a more transparent transition to DARC operation if the prime channel fails. Two-way prime channel computer/DARC interface software is now available for inclusion in revisions to the host software.

Products: 22 DARC systems -- 20 for Host ARTCCs, 1 for FAA Technical Center, and 1 for FAA Academy. Prime channel computer/DARC interface software.

Related Projects/Activities: Host, ISSS, and AAS. The DARC will provide backup for periods of transition to Host, ISSS and AAS. DARC will be removed once AAS is operational. Improved weather display capability will require DARC software modification.

SCHEDULE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DARC SYSTEM ENHANCEMENTS PHASE I
DESIGN CONTRACT AWARD
PRODUCTION CONTRACT AWARD
PRIME CHANNEL COMPUTER/DARC INTERFACE ENHANCEMENTS PHASE II
CONTRACT AWARD (9020)
CONTRACT AWARD (DARC)
1st SYSTEM DELIVERY
1st SYSTEM IMPLEMENTATION
LAST SYSTEM IMPLEMENTATION PHASE II

PROJECT 4: EARTS Enhancements

Purpose: This project will enhance air safety and increase ATC system capacity by providing radar data mosaicking, conflict alert, and minimum safe altitude warning for En Route Automated Radar Tracking System (EARTS).

Increased radar coverage allows more efficient use of airspace and reduces fuel consumption. The mosaicking of radar data in EARTS allows reconfiguring of the sectors at offshore centers resulting in improved controller workload distribution. For FAA to fully utilize the USAF's minimally attended radar (MAR) in Alaska, changes and additions to the EARTS hardware and software were necessary to interface and accept the MAR generated digital target reports and status messages.

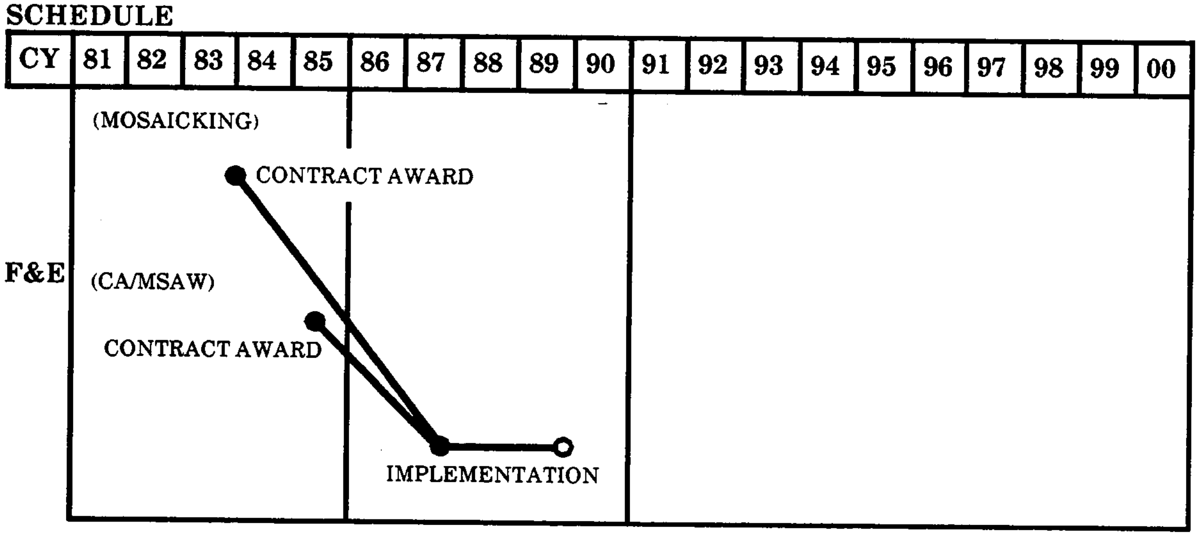
Conflict alert (CA) and minimum safe altitude warning (MSAW) capabilities will be provided to alert air traffic control personnel to potential hazardous in-flight conditions where less than standard separation exists between aircraft, aircraft and the ground, or aircraft and ground obstructions.

Approach: As the USAF's Alaskan Air Command updates and provides narrowband data from its long-range radars back to Anchorage, this data (search and/or beacon) is provided to the Anchorage ARTCC. EARTS was expanded and upgraded to utilize and display this data effectively. Mosaic software has been combined with MSAW/CA software. Delivery and key site testing of the combined package at Nellis AFB, San Juan, Honolulu and Anchorage began in August 1987. The mosaic software portion has been operationally implemented at each site. MSAW/CA operational use will follow when training is completed.

Products: Four upgraded operational EARTS.

Related Projects/Activities: The advanced automation system will replace the EARTS systems at FAA locations. FAA must also incorporate modifications to the affected MAR units to improve beacon target resolution performance. This project will require interfacility communications service from NICS. The Data Multiplexing project will provide additional transmission network savings.

SCHEDULE



PROJECT 5: Oceanic Display and Planning System (ODAPS)

Purpose: ODAPS provides automation assistance for oceanic ATC. Included is an automated conflict probe which will assist controllers in the timely identification and assignment of conflict free, fuel efficient routes and altitudes. These fuel savings will be realized without adverse impact on the ATC system.

The current use of random tracks, inefficient flight data posting, and unstructured traffic flow in the oceanic flight information regions (FIR) limit aircraft use of fuel-efficient altitudes. Oceanic controllers, confronted with an increasing number of random flight tracks, are not able to visualize the spatial relationships of aircraft from data presented on flight progress strips. The maintenance of the strip and plotting board displays and the methods for transfer of flight data are labor-intensive and antiquated. The major advancement made in the oceanic air traffic control system during the past 30 years has been the automated printing of flight progress strips.

The new system will compare the planned tracks and altitudes of different aircraft and inform the controller whether the cruising altitude or route is free from potential conflicts and when transitions can be made. This function will allow controllers to honor more flight profile requests and create a safer and more efficient environment in oceanic airspace.

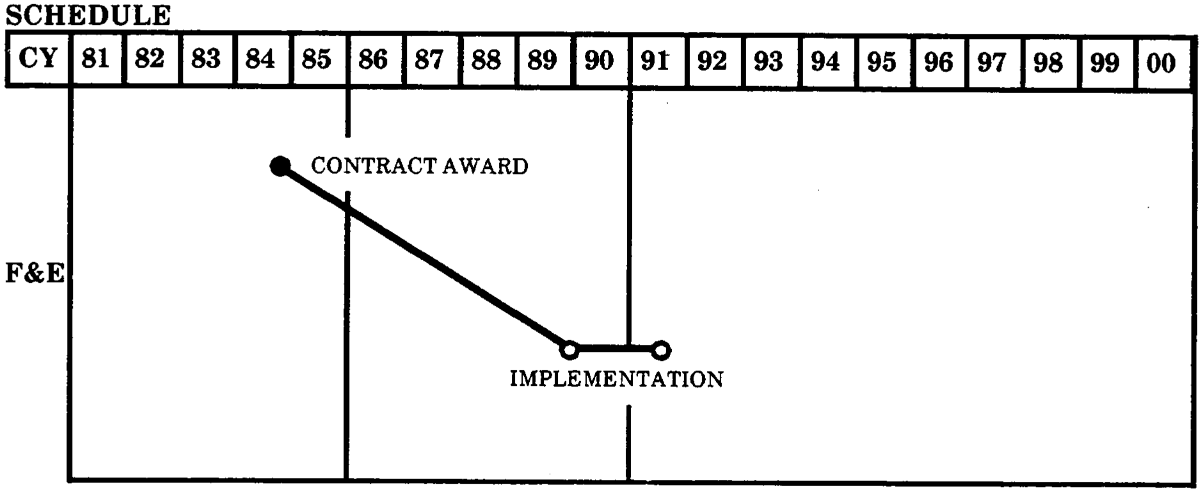
Approach: Provide oceanic automation systems comprised of situation displays, processors, and interfaces with other ATC systems, including ARINC high frequency (HF) data. The system will operate until the advanced automation system is implemented.

Products: The ODAPS contract was awarded in FY 85. Two systems have been procured for installation in Oakland and New York ARTCCs. Hardware for both systems was delivered in 1988. The basic ODAPS software, without the conflict probe capability, has been installed at Oakland and is scheduled to be operational in 1989. Enhancements to the Oakland software will be developed and implemented at Oakland in late 1990. The enhancements include conflict probe and many improvements to the man-machine interface design. After implementation is completed at Oakland, the enhanced ODAPS software will be implemented in New York and is scheduled to be operational in mid-1991.

Related Projects/Activities:

- FDIO - used for ODAPS flight data entry and display and an integral part of ODAPS.
- NADIN - will provide specific communications services.
- AAS - will include requirements for oceanic automation.
- Modern ATC Host Computer - host monitor software will be modified for use in ODAPS.

SCHEDULE



PROJECT 6: Traffic Management System (TMS)

Purpose: This project will upgrade the present flow control system into a fully integrated traffic management system (TMS) which will operate at the national level through the Central Flow Control Function (CFCF) at FAA headquarters and the local level through traffic management units (TMU) in each ARTCC and designated level 5 terminals and later at ACFs. The upgrading of the traffic management system is designed to improve air traffic system efficiency, minimize delays, expand services, and be more responsive to user requirements. Included in the TMS are: Central Altitude Reservation Function (CARF); Airport Reservation Function (ARF); Emergency Operations Facility (EOF); Central Flow Weather Service Unit (CFWSU); various flow management programs with integrated en route metering (ERM) functions, such as the departure sequencing program (DSP), en route spacing program (ESP), and the arrival sequencing program (ASP); and the hardware and software necessary to support them, including performance analysis/ evaluation functions.

Approach: The present flow control and altitude reservation system will evolve using a multi-step approach: (1) Phase I completed in FY 84, (2) Phase II will be completed in FY 91. Additional functions will be added in multiple steps aligned with the concept developments evolving from the Advanced Traffic Management System (ATMS) research and development program. These steps will be completed in FY 95.

Phase I included:

- Replacement of CFCF 9020A computer system at Jacksonville, Florida, with the IBM 4341 computer located at the FAA Technical Center.
- Relocation of CARF and the automation staff to FAA headquarters.
- Implementation of a data communications system to interface users and NAS 9020 computers at each ARTCC in a two-way data mode interfacility flow control network (IFCN).
- Installation of upgraded data terminals in CFCF.
- Improvement of departure release time software controlled departure times (CDTs).
- Implementation of static en route sector load software (ELOD) at flight level 240 and above.

Phase II focuses on the following areas:

- Implement automated DSP at selected ARTCCs and tower locations.
- Provide TMU automation new computer/terminal systems.
- Replace central flow control computer (CFCC).
- Implement ATMS Monitor/Alert function for all en route sectors as a replacement to static ELOD.
- Enhance controlled departure time (CDT) software.
- Implement ATMS aircraft situation display (ASD) in CFCF and TMU's.
- Relocate CARF processors from the development location to FAA Technical Center.
- Establish data communications links with user organizations and enhanced capability to monitor equipment status of all operational elements of TMS.
- Color graphics workstations (supplements monochrome displays) hardware and software will be located in the CFCF, FAA Technical Center, TMUs, and EOF to enhance display processing of data and to interface with the CFCC, IFCN and prime channel computer.
- Provide stand-alone color weather radar displays for the TMUs.
- Implement the ERM functions (formerly Project 8).

Following Phase II, ATMS automated demand resolution, strategy evaluation and automated message distribution functions will be implemented.

Products: The traffic management system will provide integrated hardware and software that will be highly responsive to existing and projected traffic management situations. It will also assist traffic management personnel in evaluating the impact of various alternatives which may be employed for resolving traffic management situations.

Related Projects/Activities:

- Modern ATC Host Computer - The capacity of the host computer is required for implementing the ERM integrated DSP, ESP, and enhanced ASP automation aids.

- Weather Products - Provided by the Center Weather Service Units (CWSU) via the Meteorologist Weather Processor (MWP) and the Central Flow Meteorologist Weather Processor (CFMWP), respectively will be used by the TMUs and CFCF to further enhance TMS performance.

- AAS - The traffic management system will interface with the AAS for the exchange of traffic information. AAS will perform many local traffic management functions.

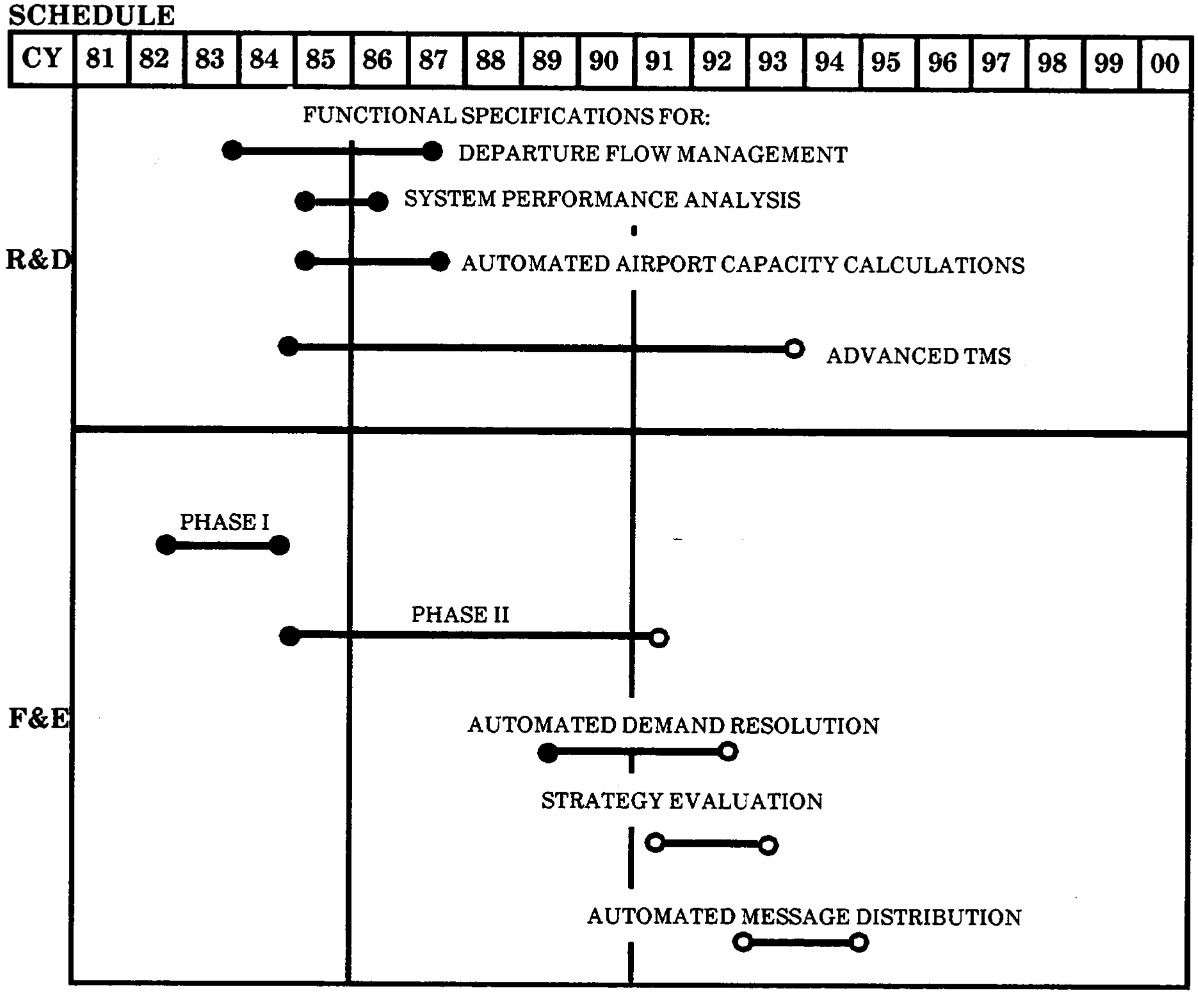
- ATMS - The post Phase II steps will rely on the products from the ATMS R&D project to define the hardware and software required to implement those functions in the traffic management system.

- AERA - AERA will incorporate and execute the en route metering and delay absorption plans developed in the en route metering project.

- NARACS - National Radio Communications System - Used in an emergency, it provides complete communications coverage with FAA headquarters, regions, field facilities, and other Government agencies.

- NICS will provide interfacility communications. Projects providing the switching and transmission network include NADIN, RML Replacement and Expansion, and Data Multiplexing.

SCHEDULE



PROJECT 9: Conflict Resolution Advisory (CRA) Function

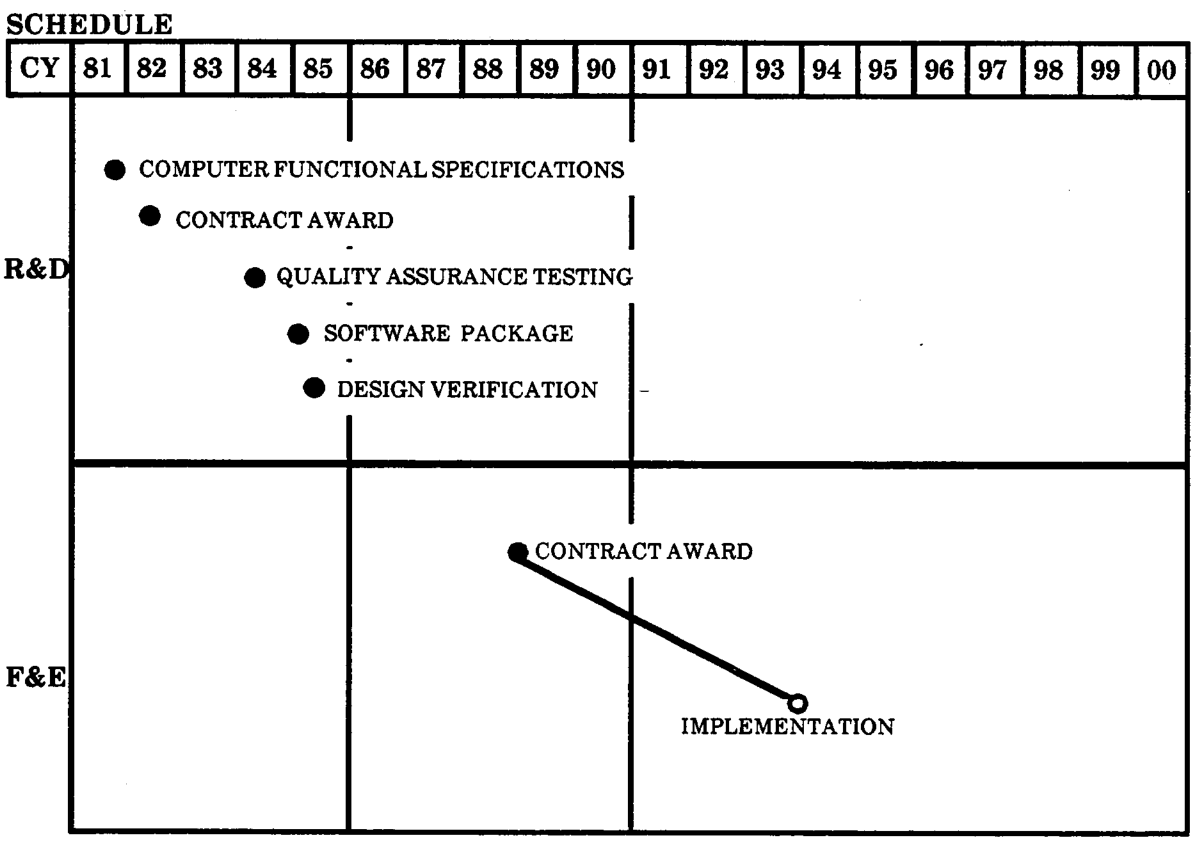
Purpose: This project will provide automated assistance to en route radar controllers in resolving potential violations of minimum separation standards. The conflict resolution advisory function will provide the radar controller with a display of several alternative solutions to potential conflicts which have been detected by the Conflict Alert (CA) function. The prime objective of conflict resolution advisories is to assist the radar controller in resolving potential conflicts. This results in reducing the number of operational errors.

Approach: Using functional specifications, a support contractor has designed, programmed and tested a prototype to incorporate the conflict resolution advisory function into the operational en route computer program. The prototype demonstrated the feasibility of CRA. The operational program is now being developed based on the data obtained from the prototype effort.

CRA will be implemented for evaluation by selected sites in the A4e0.5 host software release. Following the field evaluation and any modifications that may result, the operational CRA program will be implemented in the A4e0.6 host software release.

Products: One computer program adaptable for use at 20 host-equipped air route traffic control centers.

Related Projects/Activities: Conflict Alert/Mode C Intruder functions to be implemented in the A4e0.4 host software release are prerequisites for CRA implementation. Conflict Resolution Advisory implementation is a transitional step toward a similar function in the AAS.



PROJECT 10: Conflict Alert IFR/VFR Mode C Intruder

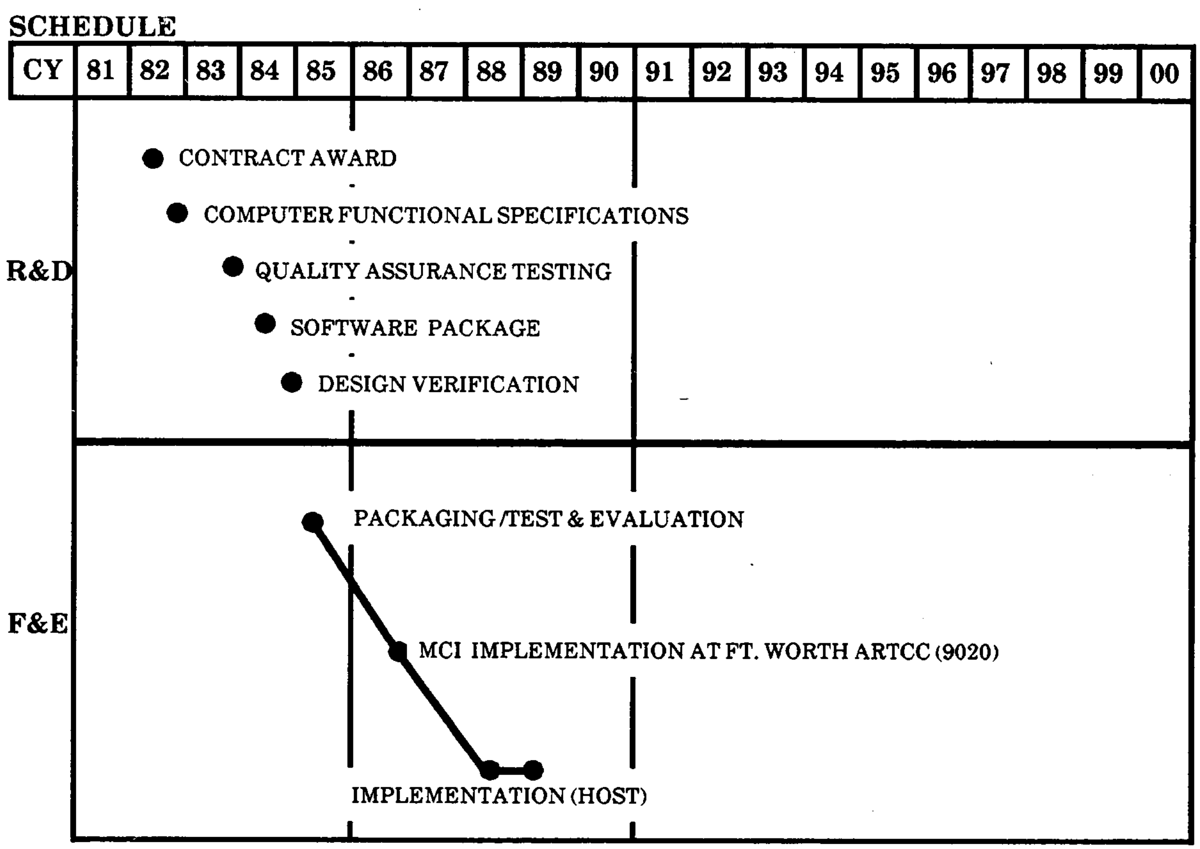
Purpose: This project will provide computer assistance to en route radar controllers to identify potential conflict situations between IFR aircraft and VFR Mode C-equipped aircraft. The conflict alert IFR/VFR Mode C intruder function is an enhancement to the conflict alert function currently in use in the en route system. This software enhancement extends the conflict alert functions to include cases where IFR aircraft are approaching potential conflict situations with VFR aircraft that are equipped with altitude reporting (Mode C) transponders.

Approach: Software to perform this function has been developed and delivered for incorporation into the NAS en route automation system, first in the 9020 and then in a revision of the host software. The Mode C intruder function was installed into the Fort Worth ARTCC host in May 1988.

Products: One computer program adapted for use at 20 host-equipped air route traffic control centers.

Related Projects/Activities: The Conflict Resolution Advisory function will use the output of the Mode C Intruder function. The host computer software has been revised to implement Conflict Alert IFR/VFR Mode C Intruder.

PROJECT COMPLETE



PROJECT 11: Voice Switching and Control System (VSCS)

Purpose: This project will provide a voice communications system which performs the intercom, interphone, and air-ground voice connectivity and control functions needed for air traffic control operations in an ARTCC and an ACF. The VSCS must satisfy the voice communications reconfiguration and service availability needs of the ACFs, reduce leased service costs, increase modularity and growth capability, and increase controller productivity.

Approach: The VSCS will use existing off-the-shelf technology adapted to meet FAA requirements. Two competing prototype systems will be produced and evaluated prior to award of a contract for the final 24 systems. The winning system at the FAA Technical Center (FAATC) will be upgraded to production specifications. The VSCS contractor will design position equipment compatible with the man-machine interface used today in ARTCCs. The VSCS position equipment will also be compatible with the man-machine interface of the sector suite. The AAS contractor will position the voice communications equipment and display devices to best fit the total man-machine interface and console design. An interface is required with the AAS for reconfiguration and status reporting purposes. A set of predetermined reconfiguration maps will be embedded in the VSCS. Capability to modify or create new reconfiguration maps from designated VSCS positions shall be provided.

In FY 84, VSCS operational requirements were finalized. The VSCS prototype systems contracts were awarded in early FY 87.

Following prototype demonstrations, a production contract award is planned in FY 90. After being upgraded to production specifications, the FAATC equipment will be integrated and tested prior to commencing field deliveries. VSCS will be implemented in the existing ARTCC consoles prior to implementation of the initial sector suite system (ISSS).

Products:

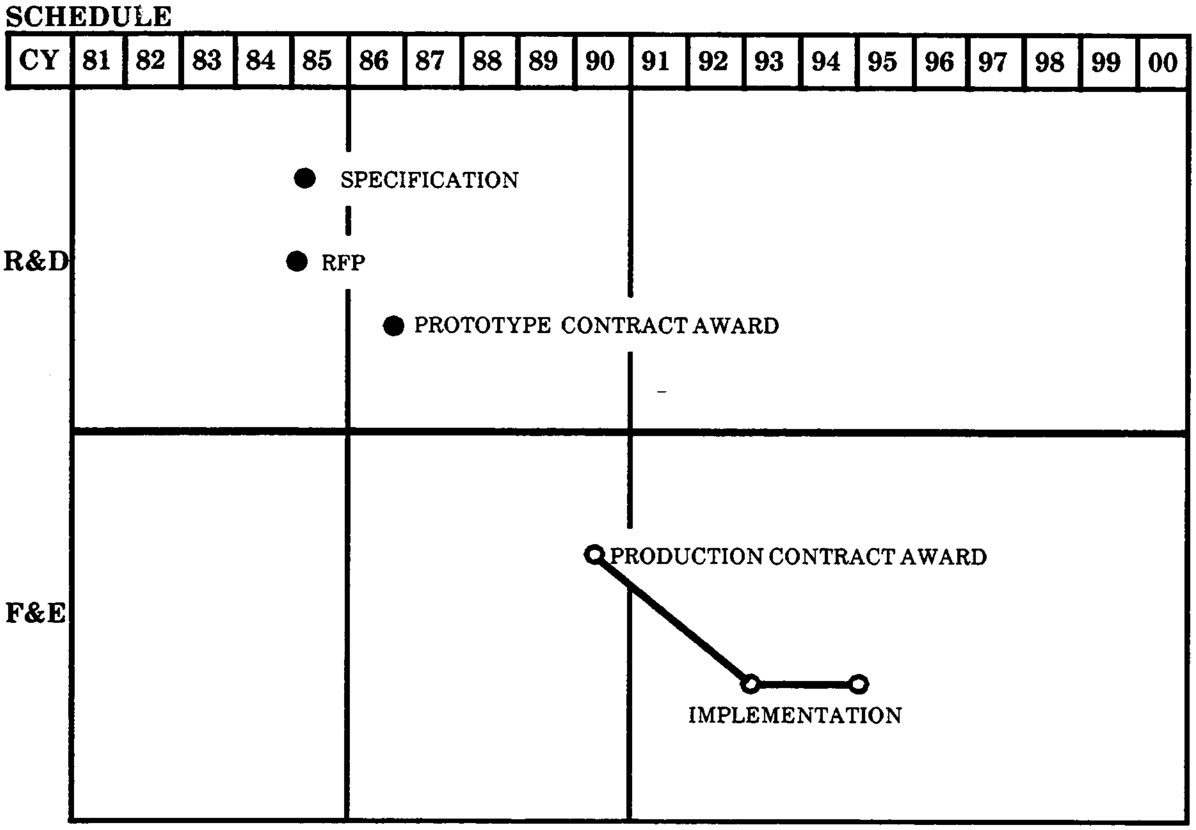
- One system per ACF, and position equipment for each operational control position.
- One system for the FAA Technical Center and one for the FAA Academy.

Related Projects/Activities:

- VSCS must be available and installed prior to the initial sector suite implementation.
- Radio Control Equipment – Performs the radio channel signaling and control functions to support ground/air voice communications.
- Multichannel Voice Recorders - To record all voice communications between air traffic controllers and pilots.
- AAS – Interfaces with the VSCS for configuration status and control data.

This project will require interfacility communications service from the NAS interfacility communications system (NICS). The project providing the required transmission network service is the RML Replacement and Expansion.

SCHEDULE



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PROJECT 12: Advanced Automation System (AAS)

Purpose: The advanced automation system will provide a new automation system that includes improved controller work stations, computer software, and processors. The advanced automation system will provide: the capacity to handle the projected traffic load through the 1990s and beyond; the capability to perform the new functions to be introduced into the ATC system through the 1990s; increased productivity through introduction of new sector suites; a high degree of reliability and availability; and the capability for enhancement to perform other functions subsequently introduced into the system.

Approach: The advanced automation system design is essentially complete. It was designed through a top down, evolutionary, total system approach that paralleled the host computer development and deployment. Controller sector suites will consist of common consoles used for both en route and terminal functions. They will incorporate an improved man-machine interface, including the use of color displays and electronic presentation of flight data to enhance controller productivity. The advanced automation system will make possible the full integration of en route and terminal operations in the area control facilities.

Transition to the AAS will consist of five steps: 1) implementation of the Peripheral Adapter Module Replacement Item (PAMRI) and Coded Time Source (CTS); 2) implementation of the initial sector suite system (ISSS) to provide new controller work stations; 3) implementation of terminal advanced automation (TAA) functions using AAS hardware and software; 4) implementation of tower control computer complexes (TCCC); and 5) implementation of Area Control Computer Complex (ACCC) for the remaining AAS en route functions.

Step one, implementation of the PAMRI and the concurrent implementation of the CTS will be completed prior to ISSS equipment delivery. The PAMRI includes replacement of the PAM, Data Receiving Group (DRG) and radar multiplexor (RMUX) equipment. This will provide an enhanced ability to interface with additional radars, and will provide a capability for use of higher data transmission rates for radar site interfaces.

In the second step, the initial sector suites will be installed in en route facilities served by the host computers. Installation requires a sterile environment previously provided by the expansion of ARTCC buildings to accommodate the host computer and by reclaiming a part of the existing control room. After transition to the initial sector suite system, the old control room will be refurbished to accommodate additional sector suites necessary for terminal consolidation.

The third step will be implementation of the TAA for TRACON functions. AAS processors, and additional sector suites will be introduced. Software functions required to process terminal radar inputs and provide arrival and departure control of terminal traffic will be implemented.

The fourth step will be the installation of TCCCs in selected airport traffic control towers. TCCCs will be installed over an extended period, beginning when arrival/departure control is provided by TAAs.

The fifth step in the evolution to full AAS is the addition of software to perform en route functions in ACFs. Additional sector suites will be installed to enable conversion of ARTCCs into ACFs. The hardware/software associated with this step will be referred to as the area control computer complex (ACCC).

In FY 84, two design competition contracts were awarded. The acquisition phase contract was awarded in July 1988. An incremental production commitment for each of the above steps will be made only upon completion of FAA acceptance and operational suitability tests at the FAA Technical Center.

Products: The scope of the AAS project includes construction and site preparation that is specifically required for the implementation of the AAS at area control facilities.

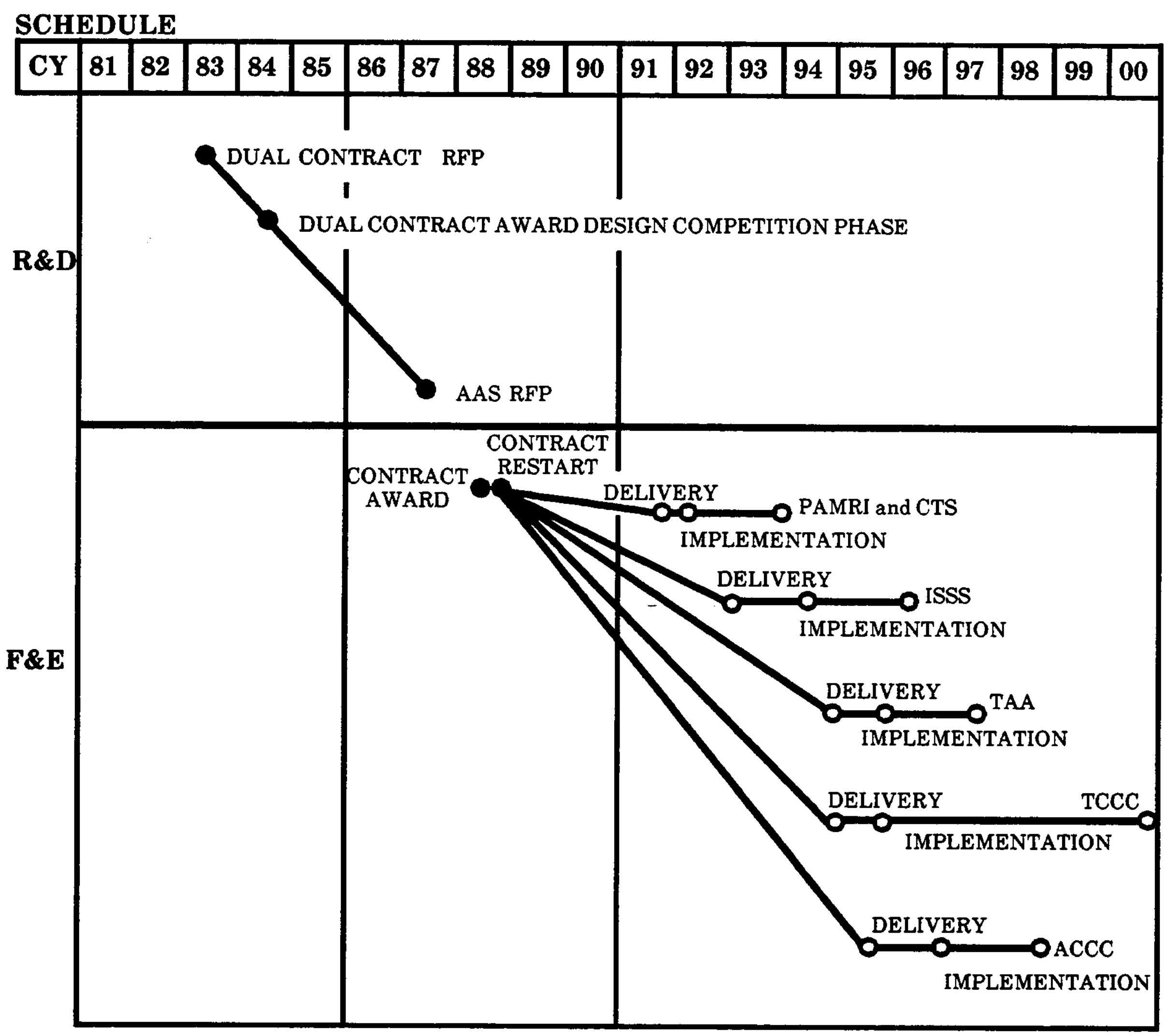
- Advanced automation system design.
- Advanced automation system software for both terminal and en route ATC operations.
- Advanced automation system computer hardware.
- ISSS (20 CONUS ARTCCs).
- TAA (at CONUS locations).
- ACCC (ACFs - including Anchorage, Honolulu, and the New York TRACON).
- TCCC (up to 258 towers).

- Support Systems at the FAATC and the Aeronautical Center.

Related Projects/Activities: The modern ATC host computer project was the first transitional step of the advanced automation program. Past development projects provided input to the sector suite and TCCC position console designs. The AAS is the automation system for the ACFs. The VSCS and Tower Communications System projects will provide the voice switching and communications necessary for AAS implementation.

The AAS en route software will include AERA 1 functions and facilitate later implementation of AERA 2/3 functions. The DARC enhancements are required in CONUS ARTCCs for the transition to AAS and will be removed following AAS implementation. CWP, DLP, Mode S, Traffic Management System, TDWR and RMMS are related projects. This project will require interfacility communications service from NICS. Projects providing the required switching and transmission network service include NADIN, RML Replacement and Expansion, and Data Multiplexing.

PROJECT UNDER REVIEW



PROJECT 13: Automated En Route Air Traffic Control (AERA)

Purpose: This project will provide interactive software for use by the area control facility to plan and monitor the 4-dimensional flow of air traffic. Specifically, AERA will: (1) permit most aircraft on IFR flight plans to fly fuel-efficient profiles, (2) increase safety of the system by reducing the potential for operational errors, (3) increase system capacity by integrating en route metering with local and national flow control, and (4) increase controller productivity by increasing the number of aircraft and volume of airspace that a control team can safely manage.

Approach: AERA will be developed in three implementation packages -- AERA 1, AERA 2, and AERA 3. AERA 1, designed primarily to provide user benefits, will be delivered with the area control computer complex (ACCC) software and will be used operationally approximately six months after ACCC implementation. AERA 1 is based on developing a 4-D flight path trajectory estimation model to support such features as:

- Flight plan conflict probe which will predict potential violations of separation standards between aircraft and between aircraft and special use (e.g., restricted) airspace.
- Sector workload analysis which will calculate and display personnel workload measures to supervisors and specialists to assist them in balancing sector staffing levels.
- Trial flight plan function which will allow controllers to evaluate alternative clearances prior to issuing them to aircraft.
- Reconformance aid which will assist controllers in reestablishing aircraft conformance with their flight plan positions.
- Reminder function which will assist controllers by reminding them of planned actions.

AERA 2 will be the first enhancement to the ACCC and is aimed primarily at increasing controller productivity. It will extend the AERA 1 functions from detecting potential conflicts to providing the controller with resolutions. It will also extend the planned action advisory function to include all planned actions, such as planned conflict resolutions, metering actions, etc., and introduce the concept of computer-generated data link clearances.

AERA 3 represents the final AERA development step and is intended to extend the AERA capability from automatic clearance generation to automatic clearance delivery via data link.

Each AERA development package will undergo a series of rigorous engineering and validation steps consisting of algorithmic development, operational suitability evaluations, computer performance functional specification development, and field implementation.

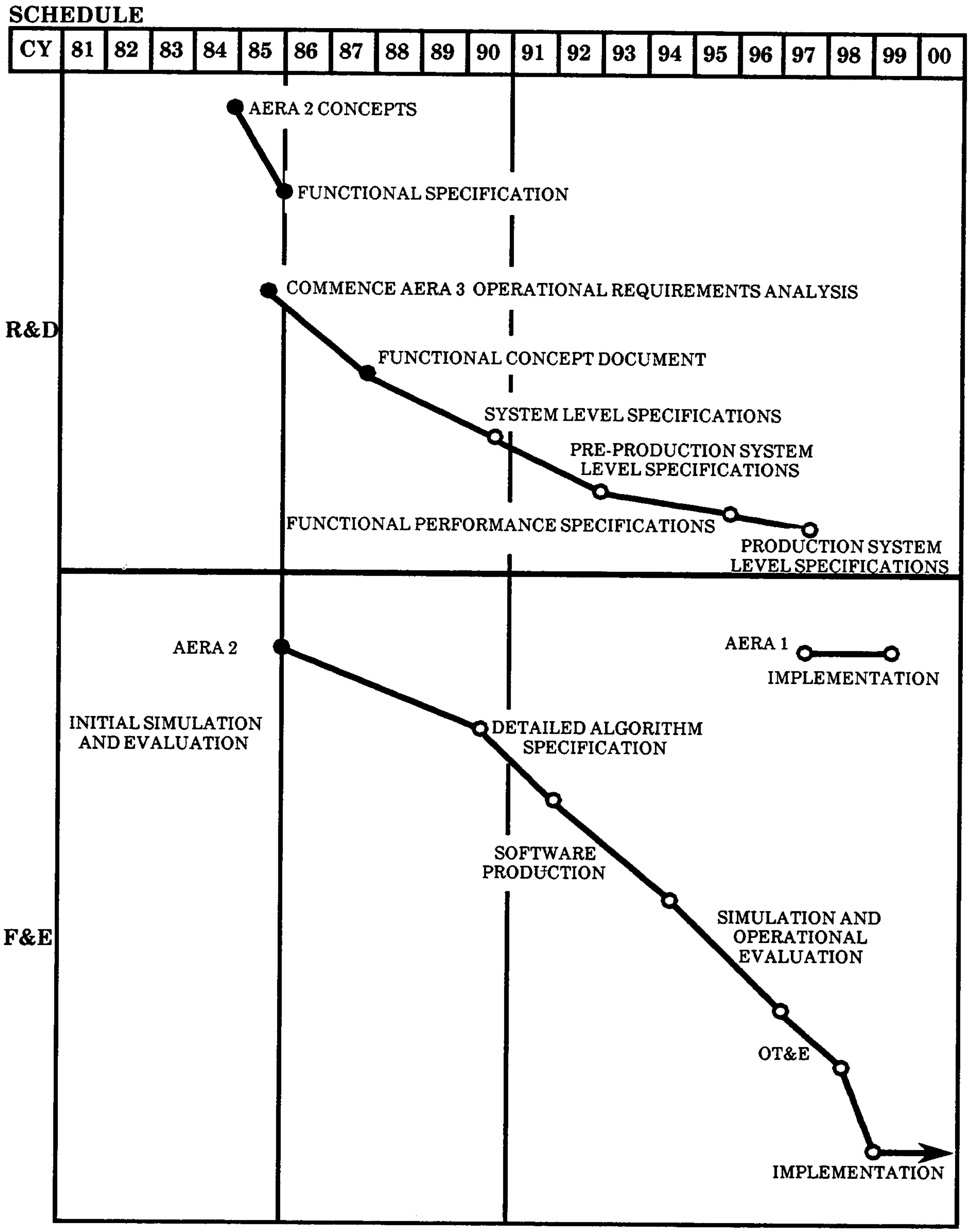
Products: Functional specifications for the AERA 1 functions were completed in FY 84. AERA 1 research and development was completed in early FY 85 and operational development will be accomplished as part of the advanced automation system. AERA 2 functional specifications were completed in FY 86. The next step in AERA 2 will be to develop performance and detailed algorithmic specifications. Then software will be prepared for ATC laboratory simulations to evaluate operational suitability. AERA 2 operational software will be finalized after operational suitability has been demonstrated. The AERA 3 concept was refined in FY 89 and the development of AERA 3 algorithms has been initiated. The contract to develop prototype versions of AERA 3 is scheduled to be awarded in FY 94. The prototype software will be evaluated at FAATC and this will lead to the development of production level specifications in FY 97.

Related Projects/Activities:

- Advanced Automation System (AAS) - The AAS will include AERA 1 functions and facilitate later implementation of AERA 2 and AERA 3 functions.
- Traffic Management System - AERA will provide key en route traffic conditions and prediction data to the traffic management system. The upgraded traffic management system will be integrated with AERA to keep both short and long-term traffic planning coordinated.
- Data Link - Interfaced through AAS, will provide automated controller/ pilot data and advisory interchange.

- Weather projects - Products provided by the Central Weather Processor (CWP) will be utilized by AERA. More accurate wind data than is currently available, provided by the weather projects, will improve AERA performance.

PROJECT UNDER REVIEW



PROJECT 15: Area Control Facilities (ACF)

Purpose: This project will improve air traffic control service to users, increase Air Traffic personnel capabilities, and absorb growth through consolidation of air traffic control facilities. Additionally, creation of ACFs improves productivity and minimizes the cost of providing identical advanced automated features to en route and terminal controllers at a large number of facilities.

ACFs will have boundaries based upon operational need and traffic flow throughout large geographical areas. The airspace associated with the ACFs will evolve from the current boundaries to more appropriate boundaries that will better accommodate the users of the national airspace system. Once full ACF implementation is achieved and the ACF environment encompasses all programmed terminal and en route airspace, the ACF boundaries can be refined in a carefully evaluated and synergistic fashion. This evolution has no predetermined length, but will maximize both the new technology and the efficiency of operation which will be gained through the consolidation of the terminal approach controls. ACFs will provide en route air traffic control and terminal arrival/departure operations as a result of facility consolidations. The ACF program does not affect the establishment or disestablishment of control towers, but will allow a full range of radar services to all terminal radar sites and provide full time service to all networked locations.

Approach: There are many programs/projects progressing concurrently in the en route, terminal, and flight service areas which will culminate in the establishment of area control facilities. The thrust of the ACF project is directed towards maximizing the capabilities of technological advances created by these programs/projects to provide even higher levels of safety, service, and efficiency in the operation and use of the ATC system. The ACF project will be accomplished in two phases:

Phase I - ACF pre-commissioning activities consist of those activities that are necessary prior to the establishment of ACFs. Major activities will include:

- ACF airspace designs.
- Upgrading environmental systems.
- Expanding and upgrading administrative and support areas.
- Monitoring and coordinating development and installation of required NAS equipment, e.g , AAS, VSCS, RCL.
- Upgrading vacated electronic equipment rooms.
- Increasing facility security.
- Modification/reconfiguration/relocation of certain existing systems to satisfy ACF requirements.

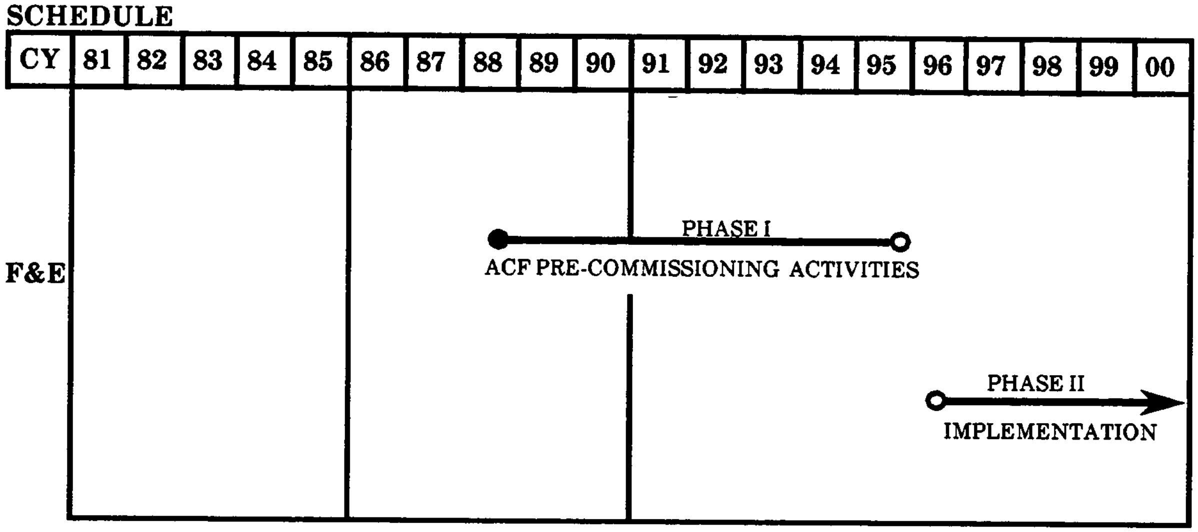
Phase I began in 1988 and is scheduled to be completed in 1995.

Phase II – ACF establishment activities consist of relocation/consolidation of TRACONs and the necessary remoting of radar interfaces and communications. Also during this time frame, the refurbishment of the space vacated by the relocated TRACONs and the modernization of the remaining tower cabs to receive tower control computer complexes will be completed. Revalidation of the ACF configuration is underway, based on the changing requirements, security and vulnerability assessments, and optimum functional distribution. Results will be reflected in the next update.

Products: Twenty-three area control facilities will provide arrival, departure, and en route control functions resulting in more efficient/effective air traffic control.

Related Projects/Activities: ARTCC Building Expansion/Modernization, Power Systems, Advanced Automation System (AAS), radar remoting and digitizing, VSCS, DLP, navaids networking, military liaison, weather programs, e.g. CWP and maintenance control centers. This project will require interfacility communications service from NICS. Projects providing the required switching and transmission network service include NADIN, RML Replacement and Expansion, and Data Multiplexing.

SCHEDULE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PHASE I
ACF PRE-COMMISSIONING ACTIVITIES
PHASE II
IMPLEMENTATION

PROJECT 16: Offshore Flight Data Processing System (OFDPS)

Purpose: This project will replace the compact flight data processing system (CFDPS) currently in use at the Honolulu ARTCC. The CFDPS consists of obsolete data processing equipment. The system is labor-intensive, provides limited functions with limited interfaces in nonreal time, uses outmoded equipment that is operating at capacity, is reaching the point where software and hardware support are diminishing, and, thus, is only marginally reliable. The replacement system will consist of modern equipment and associated software which will provide real-time enhanced functional capabilities, including comprehensive flight data processing, needed interfaces, system reliability, increased system capacity, and flexibility, while ensuring that safety is maintained.

Approach: An automated flight data processing system is being developed which will combine the flight data input/output (FDIO) system with a duplex flight data processing system (FDPS). The FDIO system will be used for data entry and display, while the FDPS will be used to process flight data.

The OFDPS duplex system will consist of redundant computers for flight data processing with a communications subsystem composed of redundant processors to provide the necessary interfaces with other systems. The adaptation software will permit modifications to satisfy Honolulu ARTCC site-specific requirements.

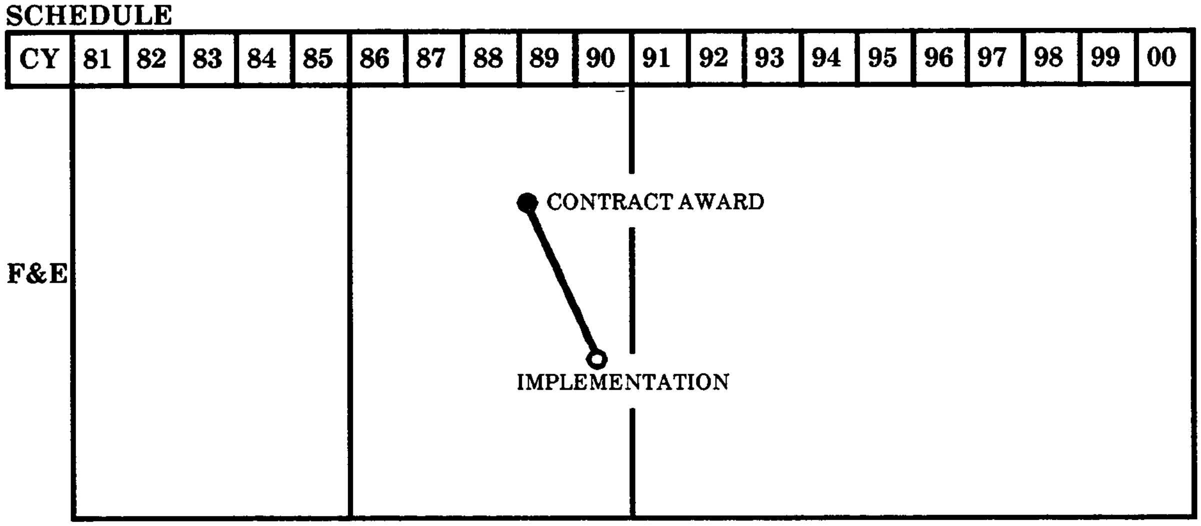
Products: One upgraded offshore flight data processing system.

Related Projects/Activities:

- FDIO equipment is scheduled for delivery to the Honolulu ARTCC and associated terminals. Operational use of OFDPS depends on the implementation of the OFDPS/FDIO software interface.

- This project will require interfacility communications service from NICS. Projects providing the required switching and transmission network service include NADIN and Data Multiplexing.

SCHEDULE



TERMINAL

sequence aircraft in the traffic pattern, expedite arrivals and departures, separate aircraft on the landing areas, and provide clearance and weather information to pilots.

The second most common are the TRACONs that control airspace around airports with moderate-to-high density traffic. TRACON controllers separate and sequence both arriving and departing flights. Normally, each TRACON is associated with one ATCT and located within the same building. However, a TRACON may be remotely located and may serve more than one ATCT. The third type, the TRACAB, serves a function similar to that of the TRACON. TRACABs are located within tower cabs at airports with lower density traffic.

All terminal air traffic control facilities are equipped with radio communications to aircraft; have telephone communications to air route traffic control centers and flight service stations; and have a variety of equipment for observing, detecting, receiving, and displaying weather information. Radios and telephones are major tools of the terminal controller.

Terminal ground-to-air communications are conducted with VHF or UHF transmitters and receivers. Current ATC ground-to-air communications require many frequency changes as aircraft move through the system. Terminal ground-to-ground communications use a variety of old switching systems. These systems are leased and range in complexity from simple systems used in many small ATCTs to Western Electric 301 and 301A systems used at TRACONs. Initial efforts for improving the terminal and other communication systems are covered in the Flight Service and Ground-to-Air chapters.

At qualifying terminal ATC facilities, computers are used to relieve the controller of routine tasks and give the controller information that assists in

the terminal automation systems. It is a non-programmable, numeric beacon decoder system. That is, information from an aircraft's transponder is decoded and displayed for the controller in numeric form along with normal radar data. It provides aircraft transponder code and altitude information for suitably equipped aircraft. TPX 42 is used at lower activity terminal radar facilities.

The automated radar terminal system (ARTS II) is a programmable, nontracking data processing system. Although it does not provide tracking, the ARTS II does provide meaningful information such as aircraft identification and altitude to the controller. Like TPX 42, ARTS II derives its information only from the aircraft's transponder. ARTS II can be interfaced with the ARTCC computer for the automatic exchange of information. ARTS II is used for facilities having low-to-medium activity. At present, ARTS II has no unique software other than minor adaptations to the basic operational program.

The automated radar terminal system (ARTS III) is a programmable beacon tracking system. Based on information from the aircraft's transponder, the ARTS III detects, tracks, and predicts the position of aircraft in the terminal area. The information is displayed on the controller's radar scope by means of computer-generated symbols and alphanumeric characters, along with normal radar data. The computer displays aircraft identification, altitude, ground speed, and flight plan data. In addition, the ARTS III is interfaced with the ARTCC computer allowing the computers to exchange information.

At present, ARTS III is installed at medium-to-high activity terminal facilities. Currently, there are two unique features provided by ARTS III through software. The first is the minimum safe altitude warning (MSAW). MSAW is a function of the ARTS III computer that will alert the controller when a tracked aircraft, with altitude reporting capability, is below or is predicted by the computer to candidates for computer processing. Like ARTS III, ARTS IIIA interfaces with the ARTCC computer and contains the unique software features of MSAW and conflict alert.

Flight data entry and printout (FDEP) provides an automated means of printing terminal flight progress strips. FDEP equipment interfaces with the ARTCC computer and is used extensively throughout the system to exchange flight data automatically between ARTCCs and terminal approach control facilities and associated control towers.

Bright radar indicator tower equipment (BRITE) is a supplemental radar display and alphanumeric system designed for use in the bright light environment of the ATCT cab.

The current terminal ATC system consists of over 400 ATCTs and nearly 200 TRACON/TRACABs.

THE NEW APPROACH

The objectives of the terminal system improvement plan are to maintain a very high level of safety; impose minimum constraints consistent with efficient use of the system; and, at the same time, minimize FAA operations costs. This involves extended use of automation and reduction of required air traffic control facilities.

For the initial effort, the new approach means making hardware and software improvements to existing ARTS automation systems and improvements to the supporting facilities and voice communication switching systems.

productivity. The TRACONs and TRACABs which currently exist will be consolidated into area control facilities (ACFs). This will blend the separate functions of terminal and en route air traffic control into ACFs. Supporting ATCTs will remain. Facility consolidation is expected to reduce the flight coordination between pilots and controllers and result in significant savings in equipment, personnel, and operating costs. Upgrading automation and voice communication switching will be the cornerstones of facility consolidation.

The advanced automation system (AAS) in the ACFs will support both en route and radar approach control functions. The sector suites used for radar approach control will be identical to those used in en route air traffic control.

Tower control computer complexes (TCCCs) will be developed for ATCT use. Area control facility sector suite components will be used to the maximum extent possible, but will have unique display characteristics for use in the space-limited, high-intensity light environment of the ATCT cab. TCCCs will satisfy the tower requirements for radar position display, intent and identity information, flight data, weather data, and flow planning information.

The consolidation of these TRACONs and TRACABs into the ACFs will improve air traffic productivity and provide significant cost-savings by eliminating multiple life-cycle costs for operation, training, supply support, engineering, and software associated with ARTS systems.

reduce nuisance alarms.

Additional ARTS II displays were provided for eight locations. ARTS III memory was expanded at initial locations to provide capacity for traffic growth. The capability to hand off aircraft and transfer flight data automatically between ARTS II and ARTCC facilities was added to reduce controller workload at most facilities. An automated ATC capability in the R-2508 restricted area of California was created to prevent midair collision of civil and military aircraft. The first integrated communications switching system (ICSS) was provided to decrease leased communications costs. Additional power conditioning systems were installed at ARTS III locations to improve reliability. A second ARTS system and a modernized software assembly system were installed at the FAA Technical Center to sustain the system support functions. Research and development were begun on the advanced automation system, including the unique features required of the tower suites.

NEAR TERM (TO 1990)

Design of ARTCC modifications and expansions to accept ACFs has begun.

Upgrading of ARTS IIs and replacement of TPX 42s to provide tracking capability and software for conflict alert and MSAW has begun. Enhanced conflict alert for ARTS IIIA and the New York TRACON is being implemented. All ARTS IIs (with the exception of Hawaii and Alaska) have been

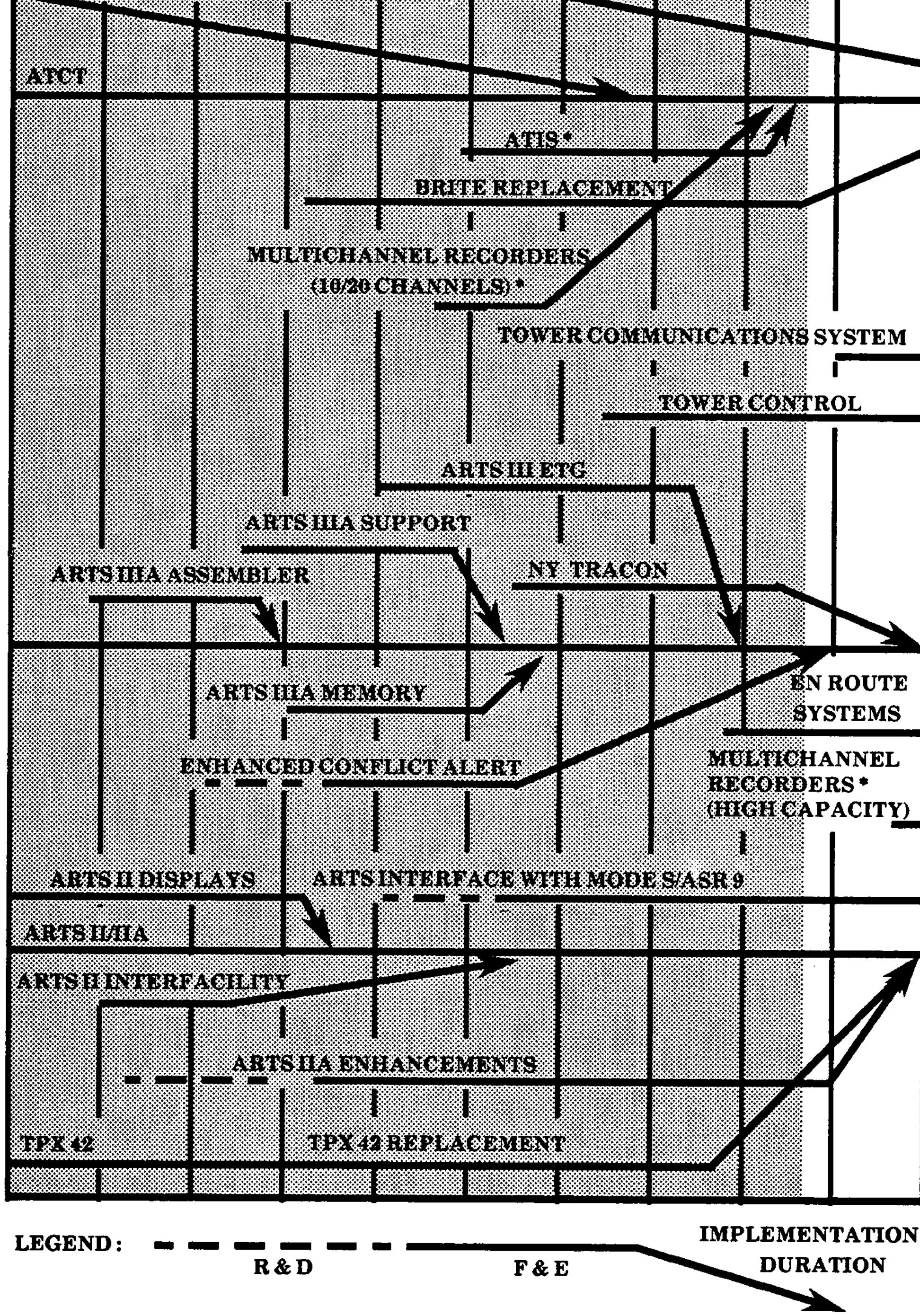
Improvements to the New York TRACON automation system to sustain operations with increased capacity are underway.

Construction for consolidated area control facilities will be underway. Research and development will be completed for sector suites, TCCCs, and voice switching and control systems. ATCT relocations and modernization will continue along with research into flow management. Modification of ARTS IIA facilities at airports served by ASR 9/Mode S surveillance systems to accept higher quality Mode S data and digitized radar input will be underway.

LONG TERM (TO 2000)

Over the long term, the FAA plans to complete consolidation into area control facilities. The advanced automation system, TCCCs, and voice switching and control systems will allow operations personnel to handle increased traffic without a proportional increase in staffing. Tower communications switching systems will be upgraded at ATCTs. Improved weather products will be available at the sector suite. Computer software will be implemented for flow management products. Data link coverage will be extended down to 6,000 feet and will be utilized to provide weather and clearances to aircraft.

The following diagram and maps describe the evolution of the system.


ATCT
ATIS*
BRITE REPLACEMENT
MULTICHANNEL RECORDERS
(10/20 CHANNELS)*
TOWER COMMUNICATIONS SYSTEM
TOWER CONTROL
ARTS III ETG
ARTS IIIA SUPPORT
ARTS IIIA ASSEMBLER
NY TRACON
ARTS IIIA MEMORY
EN ROUTE
SYSTEMS
ENHANCED CONFLICT ALERT
MULTICHANNEL
RECORDERS*
(HIGH CAPACITY)
ARTS II DISPLAYS
ARTS INTERFACE WITH MODE S/ASR 9
ARTS II/IIA
ARTS II INTERFACILITY
ARTS IIA ENHANCEMENTS
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TPX 42 REPLACEMENT
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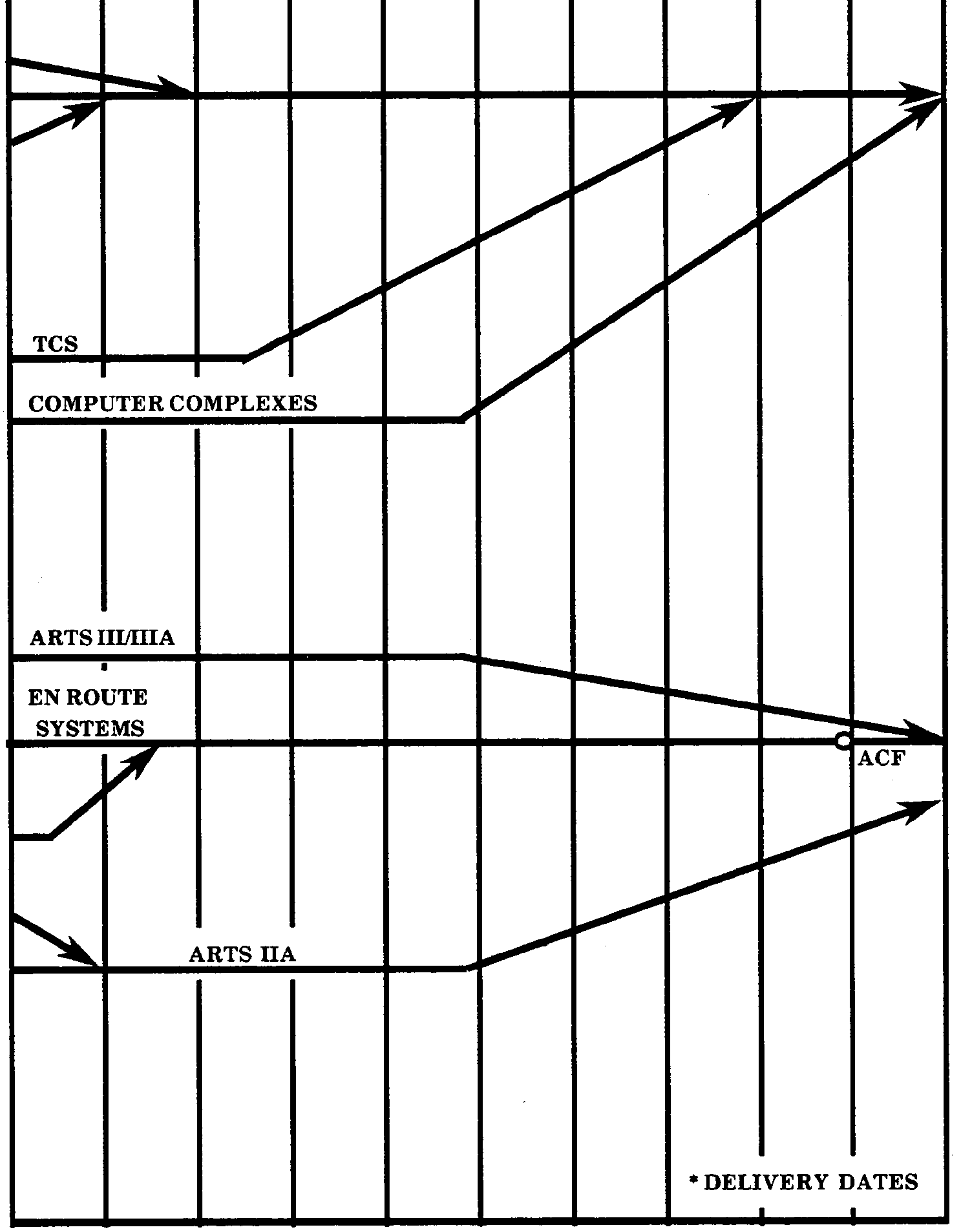
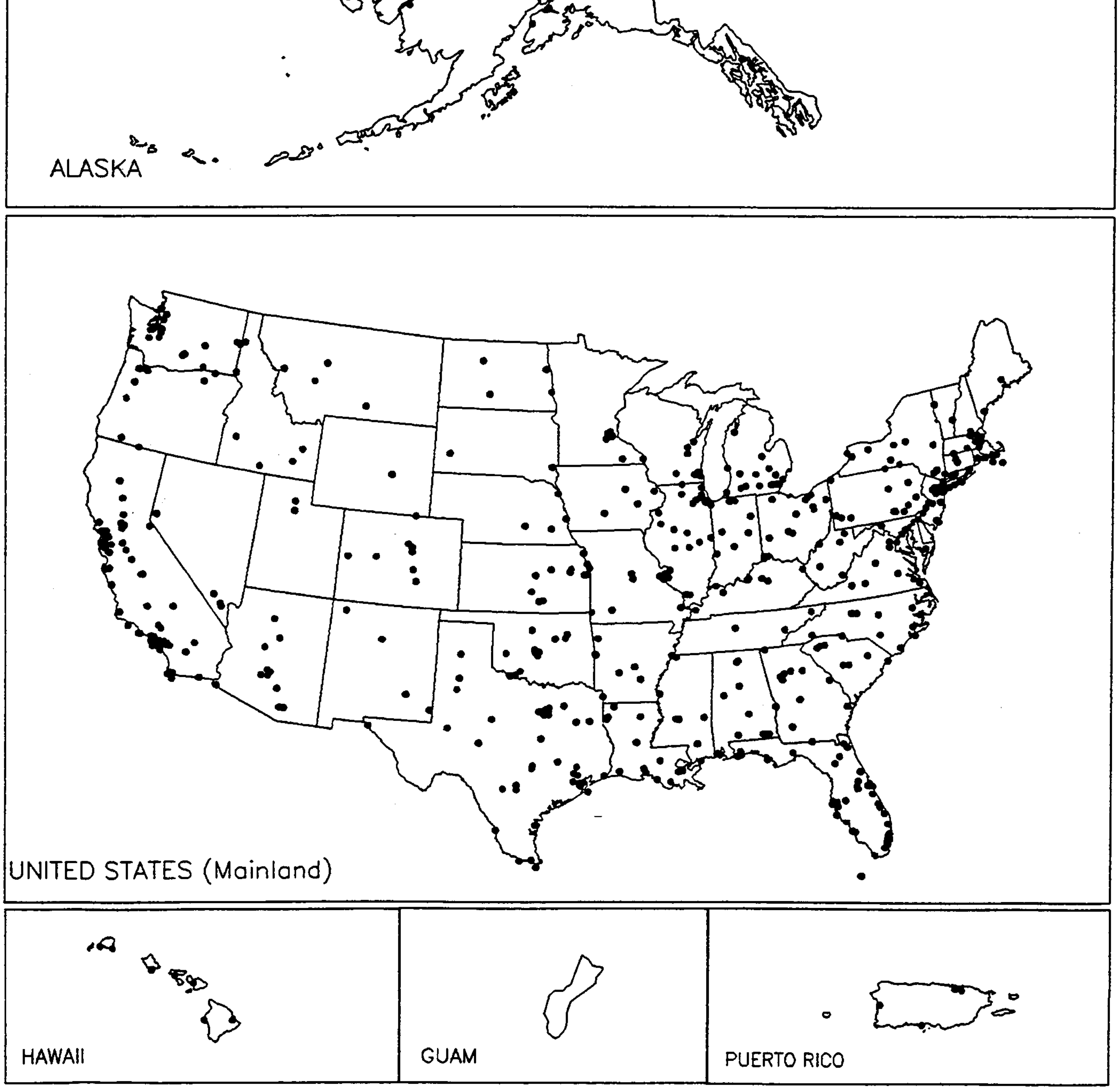


TERMINAL ATC SYSTEMS EVOLUTION



1985 SYSTEM
AIRPORT TRAFFIC CONTROL TOWERS

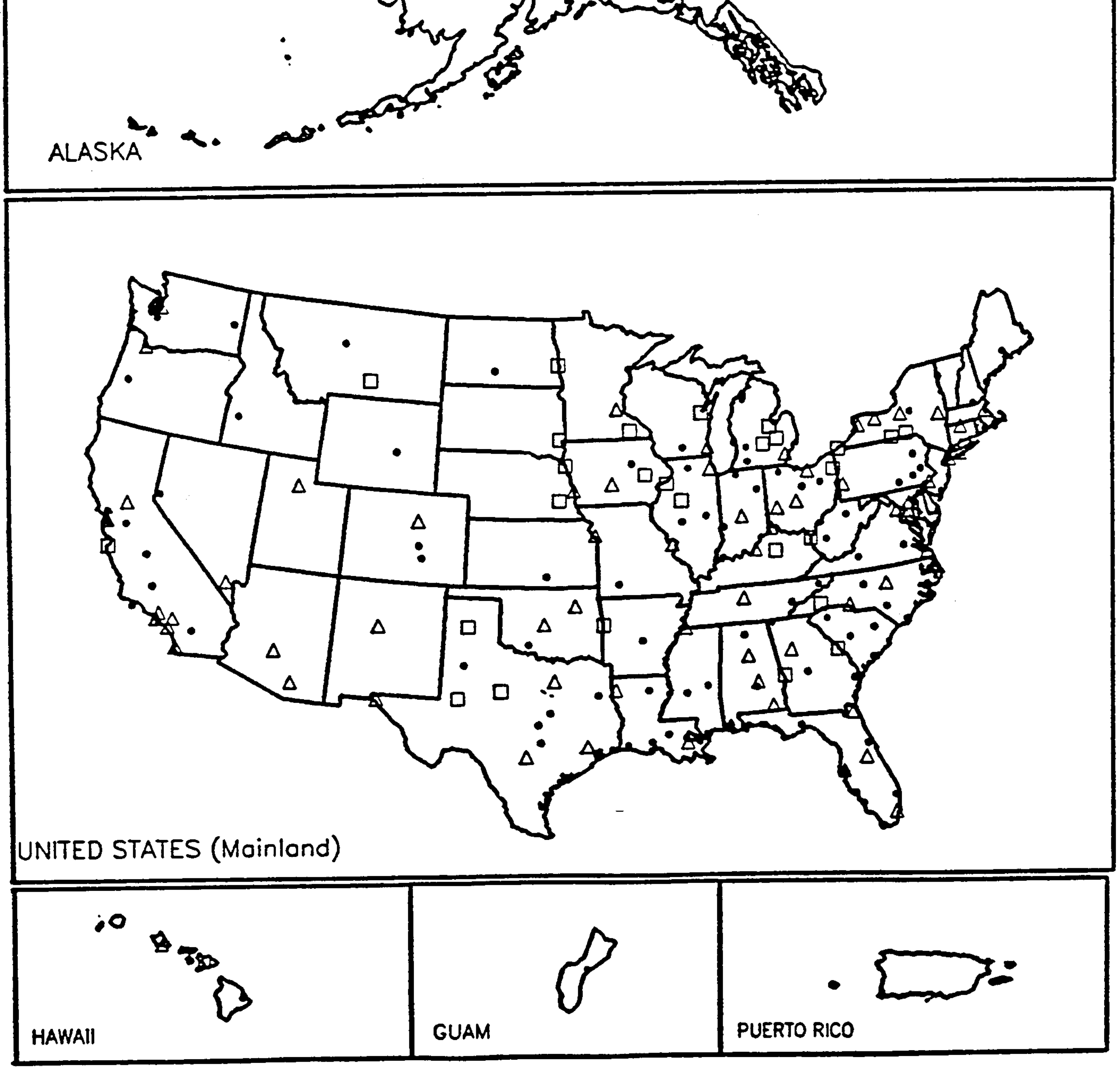
BY THE YEAR 2000, ALL ARTS SYSTEMS WILL BE DECOMMISSIONED AS THE RADAR APPROACH CONTROL FUNCTIONS ARE MERGED INTO THE AREA CONTROL FACILITIES. RADAR DISPLAYS IN THE TOWERS WILL BE REPLACED BY THE TOWER SUITE DISPLAYS, RECEIVING DATA FROM THE ACF COMMON RADAR DATA BASES.

<u>1981 - 1990 SYSTEMS</u>

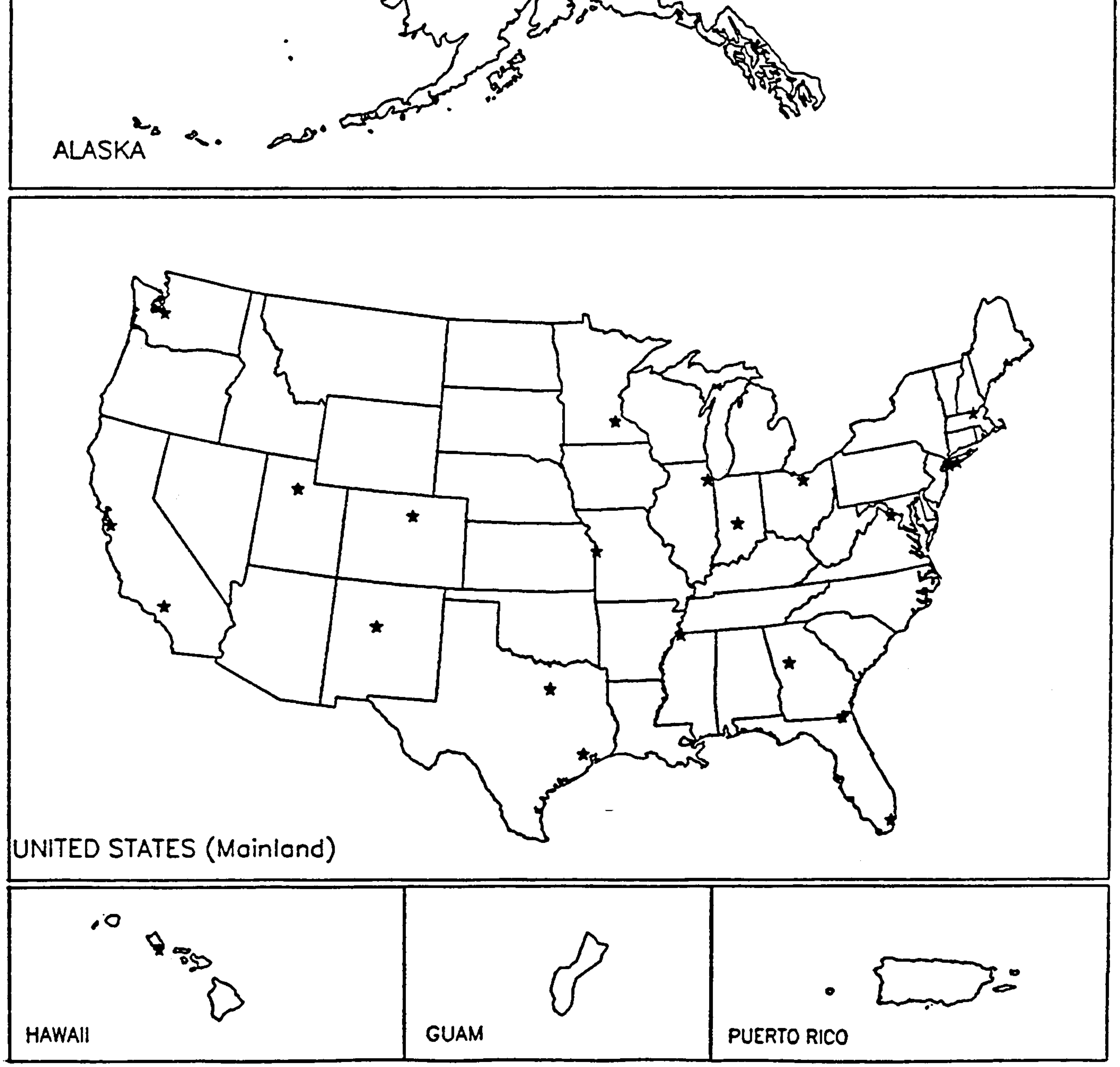
● ARTS II LOCATIONS

△ ARTS III LOCATIONS

□ TPX 42 LOCATIONS

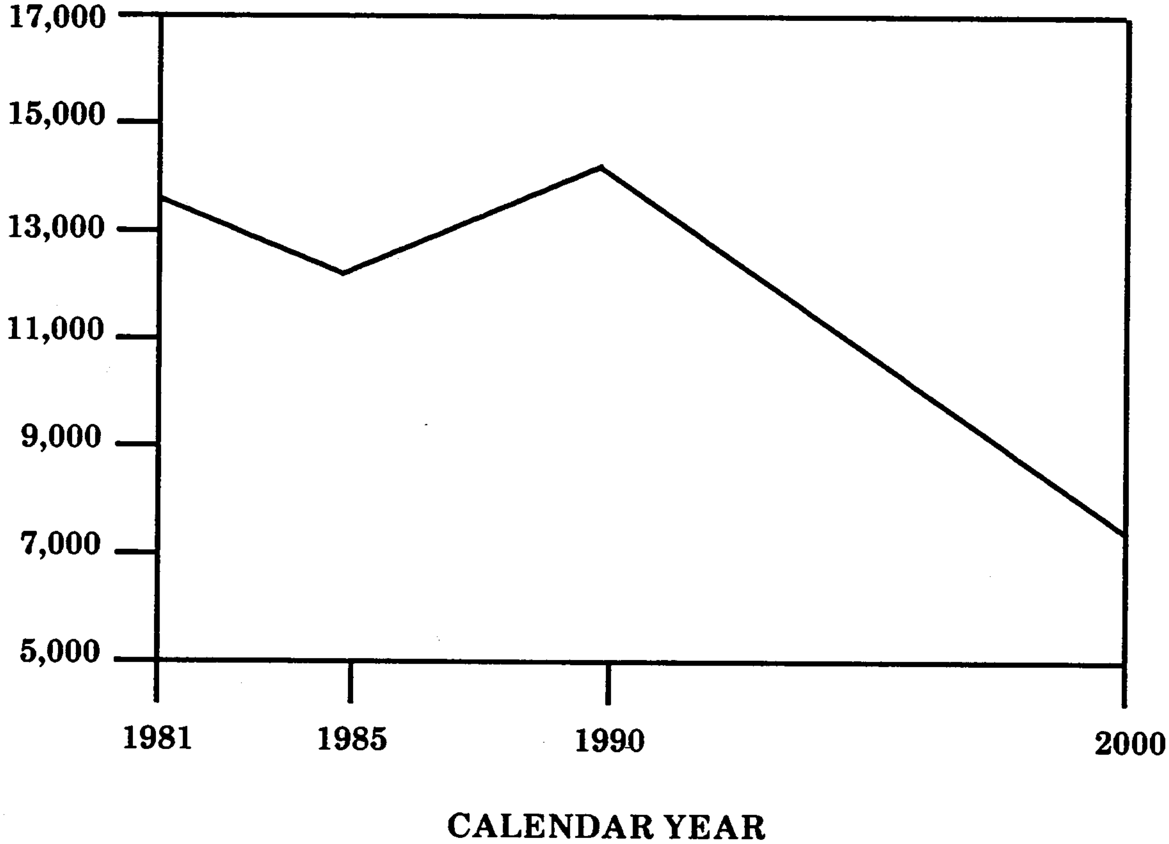


1981 - 1990 SYSTEM
AUTOMATED TERMINAL RADAR AIR TRAFFIC CONTROL FACILITIES



2000 SYSTEM
AREA CONTROL FACILITIES

by 15 percent.



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(TERMINAL SYSTEMS)

tions due to facility eliminations, transfer of seven non-radar approach control facility functions to ARTCCs, and terminal position review.

1990 - AF staffing will decrease slightly as more reliable and maintainable equipment is installed, to operate and support terminal facilities will be down to 7,619.

Outyear estimates are reviewed annually and are subject to revision.

TERMINAL SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES
AND CORRESPONDING PERSONNEL COSTS
(1981 Dollars)

	1981	1985	1990	2000
Operations (Millions)	61.6	57.9	64.0	80.2*
Air Traffic Personnel	11,800	10,321	12,259	6,464
AT Productivity Quotient	5,220	5,610	5,221	12,407
Airway Facilities Personnel	1,849	1,885	1,791	1,155
AF Productivity Quotient	33,315	30,716	35,734	69,437
Total AT & AF Staffing	13,649	12,206	14,050	7,619
Air Traffic Personnel Costs (Thousands)	$351,640	$306,534	$364,092	$191,981
Airway Facilities Personnel Costs (Thousands)	$63,051	$64,279	$61,073	$39,386

* Tower services only. Approach and departure control services will be performed by ACFs.

route and terminal air traffic control by providing full access to traffic, flight, and weather data bases available in ACFs. Terminal facilities (including airport traffic control towers and radar approach control facilities) and terminal equipment (including automation and BRITE displays) must receive an appropriate degree of modernization to sustain cost-effective operations prior to this transition. Moreover, guidance, surveillance, weather, and communications aids must receive upgrades and service improvements (as described in Chapter IV) to optimize system performance or provide the foundation for service improvement through the next decade.

The Flight Service and Weather Systems portion of the NAS Plan contains improvements required to modernize flight and weather services which also affect terminal system performance. Foremost among them: ICSSs for towers replace obsolete and expensive leased systems, AWOS systems for airports improve weather observations, more LLWAS systems alert controllers of potentially hazardous wind conditions, and TDWR systems alert controllers of microbursts and other hazardous wind shear conditions.

Projects in Chapter V, Interfacility Communications Systems, improve the reliability, efficiency, and cost-effectiveness of communicating digital and voice information between towers, ACFs, and remote facilities. This chapter also implements television microwave links needed to provide radar data to satellite towers.

Chapter VI, Maintenance and Operations Support Systems, improves the maintenance, flight inspec-

The ARTS IIIA systems are receiving software enhancements to predict potential flight conflicts more accurately and reduce the nuisance alarms that impact the usefulness of this function during peak traffic hours. ARTS IIIA systems received additional memory to accommodate traffic growth. Power conditioning systems are being added at ARTS IIIA sites (see Chapter VI). New digital displays at New York TRACON have allowed for relocation of existing displays to provide interim training enhancements at other facilities. In order to sustain the national system support capability, a second ARTS system has been purchased for the FAA Technical Center.

The ARTS II facilities will be upgraded to support tracking capabilities and enhancements similar to those provided in the ARTS III. New displays have been bought and installed at TRACAB locations. ARTS II facilities have been interfaced with the ARTCC computers to provide automatic hand-offs and interchange of flight plans. The TPX 42 beacon decoding systems are being replaced with ARTS IIA to provide standard levels of automated display capability.

COMMUNICATIONS

Communications improvements complement the advances in automation, and use in the towers will continue indefinitely. The automatic terminal information service recorders and voice recorders have been replaced with highly reliable units. A voice communications control and switching system will be installed to maximize the benefits of the tower suites.

	PROJECT COMPLETE	1988
3. Enhanced Target Generator (ETG) Displays (ARTS III)	PROJECT COMPLETE	1988
4. Additional ARTS IIIA Memory	PROJECT COMPLETE	1986
5. Additional ARTS IIIA Support at the FAA Technical Center	PROJECT COMPLETE	1986
ARTS II		
6. ARTS IIA Enhancements	1989	1990
7. ARTS II Displays	PROJECT COMPLETE	1984
8. ARTS II Interfacility Interface	PROJECT COMPLETE	1986
9. ARTS IIA Interface with Mode S/ASR 9	1990	1991
COMMUNICATIONS		
10. Automatic Terminal Information Service (ATIS) Recorders *	PROJECT COMPLETE	1989
11. Multichannel Voice Recorders *	1986	1992
12. Tower Communications System (TCS)	1993	1998
OTHER FACILITIES AND EQUIPMENT		
13. ATCT/TRACON Establishment, Replacement, and Modernization	1981	1992
14. VFR ATCT Closures	PROJECT COMPLETE	1987
15. Combine Radar Approach Control into ARTCC	PROJECT	DELETED
16. Bright Radar Indicator Tower Equipment (BRITE)	1989	1991
17. TPX 42 Replacement	1988	1990
18. Sustain the New York TRACON	1989	1990

* Depot Delivery Dates

PROJECT SUMMARY

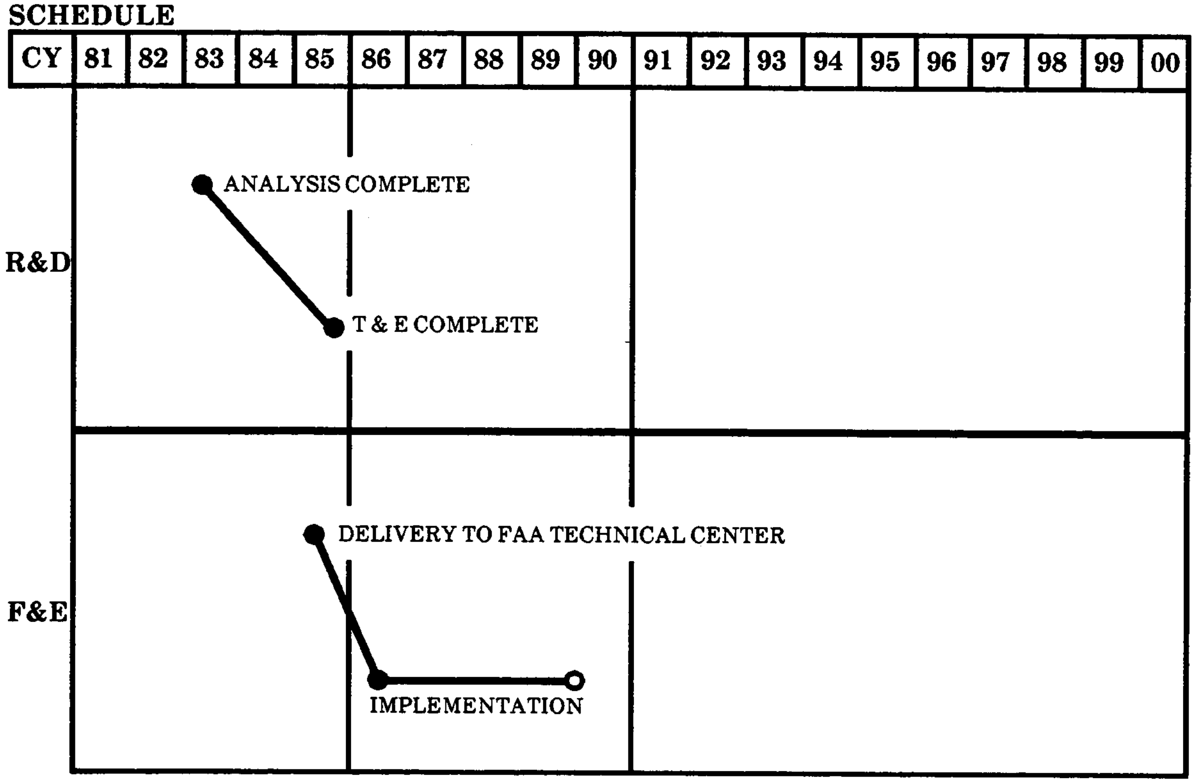
number of nuisance alarms requires optimum conflict detection in environments where larger numbers of aircraft are closely maneuvering, landing, and departing, and where simultaneous parallel approaches are regularly conducted.

Approach: Software enhancements will be procured to resolve problems in conflict alert. Outstanding issues that require research and resolution are:

Products: One software modification installed at 61 ARTS IIIA locations and the New York TRACON. The software modification package was delivered to the FAA Technical Center in mid-1985 for integration, on a site specific basis, into the operational program. Implementation began in mid-1986.

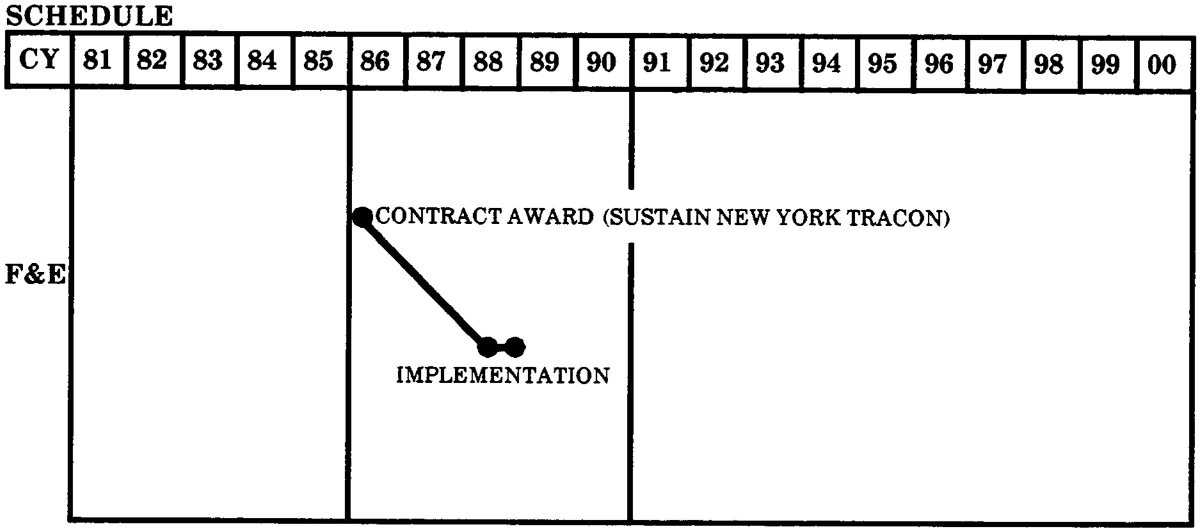
Related Projects/Activities: ARTS IIA Enhancements – the addition of conflict alert to ARTS II is a program that is similar in function.

SCHEDULE



PROJECT COMPLETE

SCHEDULE

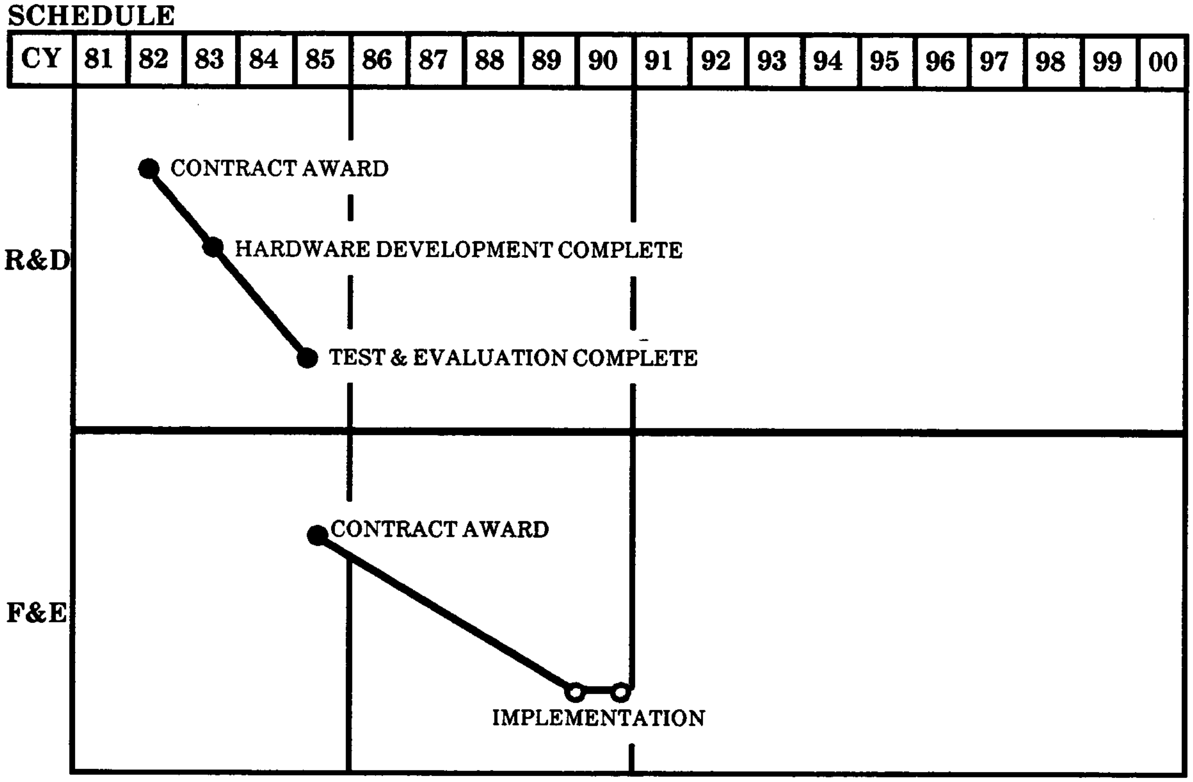


Approach: Procure equipment, software, and services to provide conflict alert, minimum safe altitude warning (including cartographic support), training target generator, and tracking for ARTS II. Software will be developed using techniques and methods currently in use in the ARTS II and ARTS IIIA systems and will be implemented after the ARTS IIA hardware is deployed.

ARTS IIA enhancement.

- NICS - Interfacility communications will be provided by NICS.

SCHEDULE

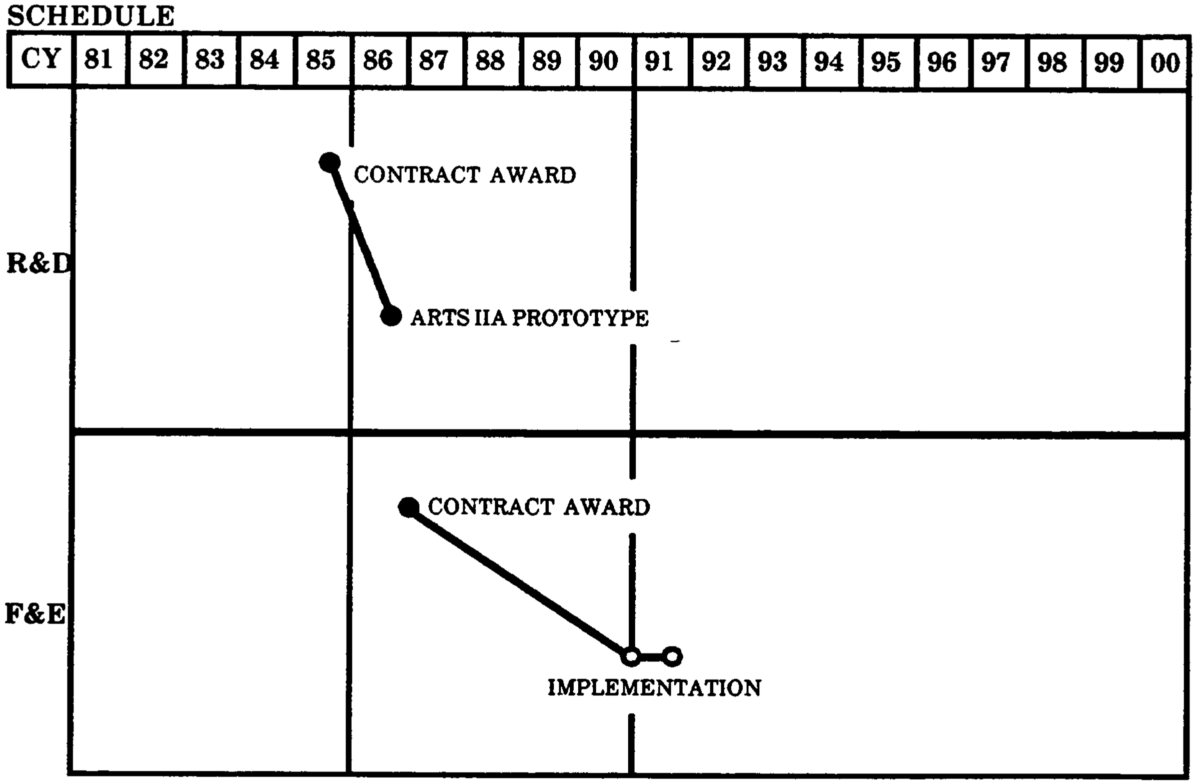


Approach: Develop, test, evaluate, and implement hardware and software modifications so that those ARTS IIAs operating with Mode S/ASR 9 can receive CD-type messages and reformat the data to provide the ATC display required for ARTS operation.

ASR 9 equipment to be interfaced to ARTS IIA.

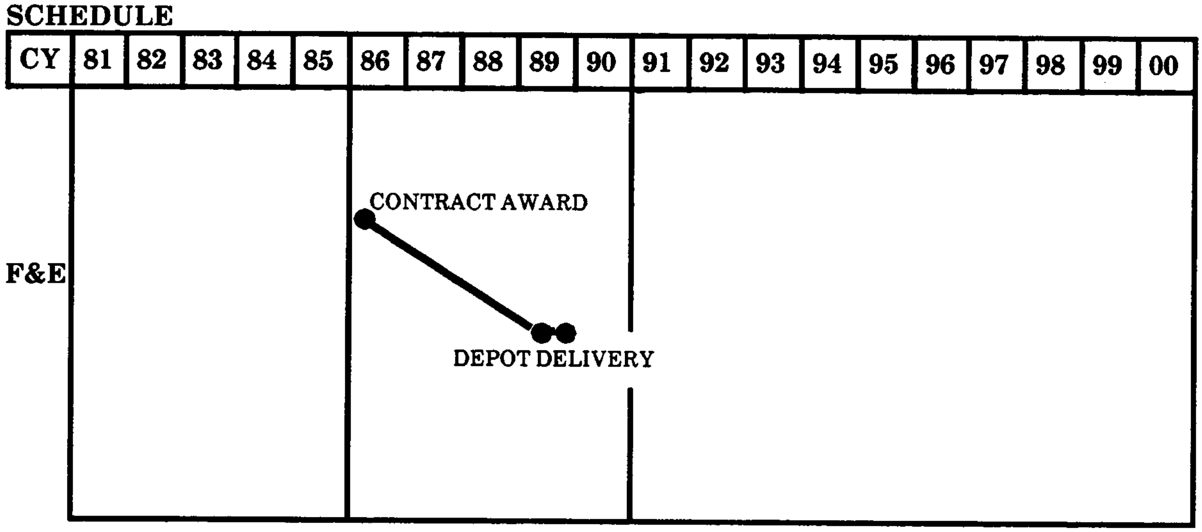
- NICS - Interfacility communications will be provided by NICS.

SCHEDULE



PROJECT COMPLETE

SCHEDULE



supply/support problems because their production has been discontinued by the manufacturer.

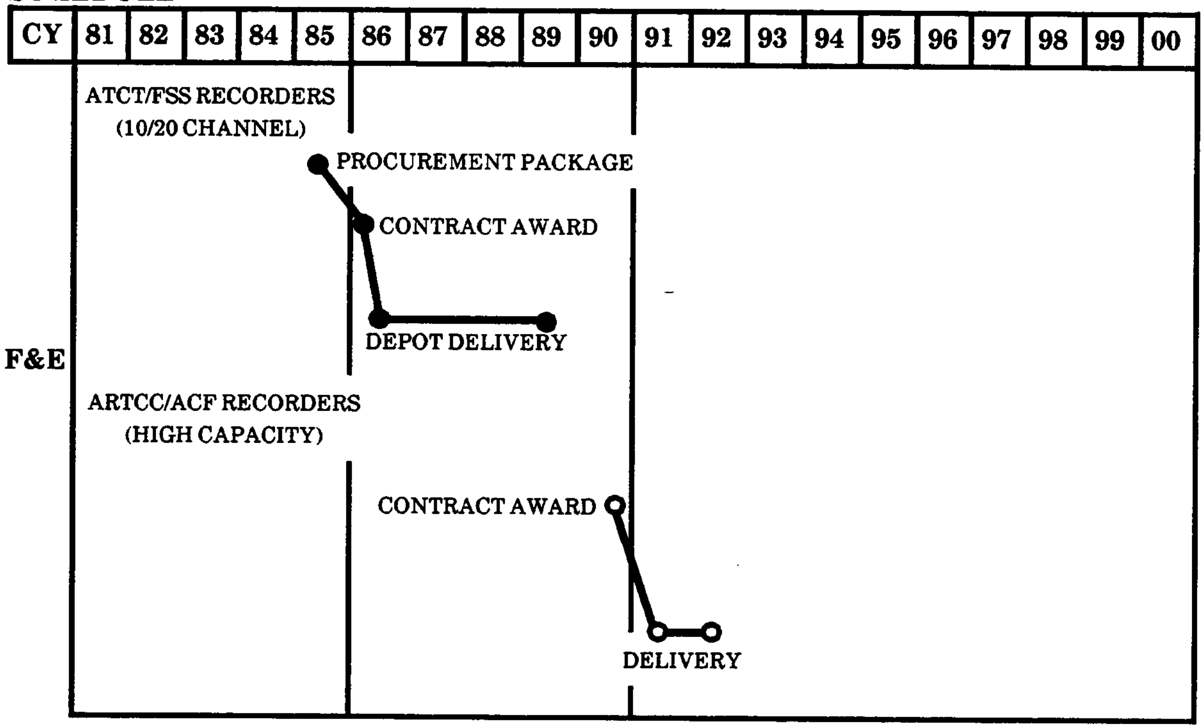
Approach: 10 and 20 channel recorders are to be used for replacement of the remaining 5 and 9 channel equipment, and for establishment, relocation, and modernization of ATCTs as necessary. Additionally, certain FSSs and AFSSs will also receive the 10 and 20 channel recorder units. High-

ments, relocations, and depot spares.

- 165 high-capacity units for ARTCCs/ACFs, TRACONs, and training/test facilities.

Related Projects/Activities: All voice communications switching systems at air traffic control facilities such as VSCS, ICSS, and TCS, will require recording equipment.

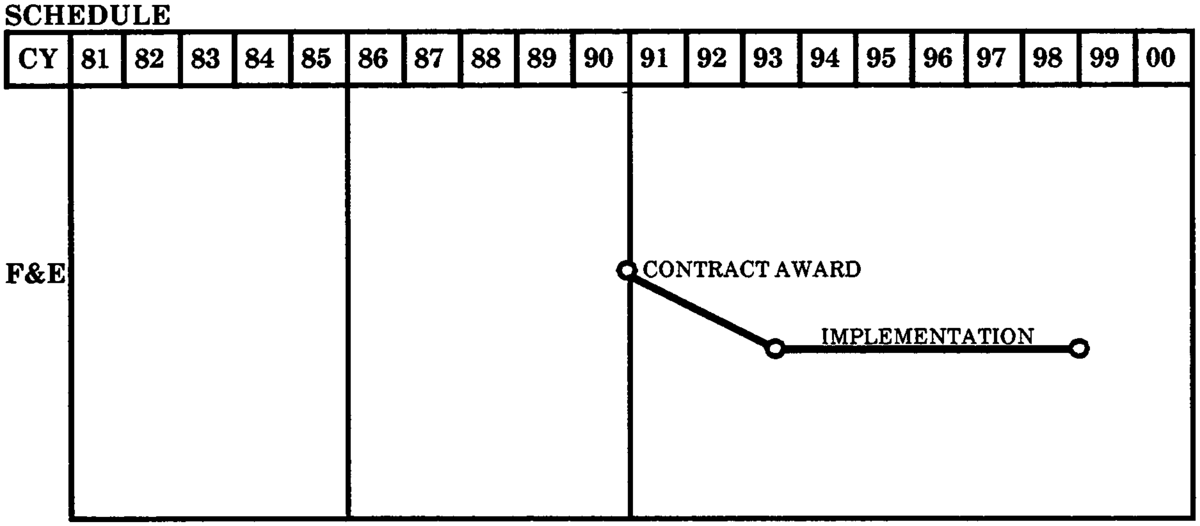
SCHEDULE



towers (ATCTs) are either leased systems with limited operational features or the more modern integrated communications switching systems

Related Projects/Activities: ICSS, Radio Control Equipment (RCE), VSCS, NICS, RMMS, and TCCC.

SCHEDULE



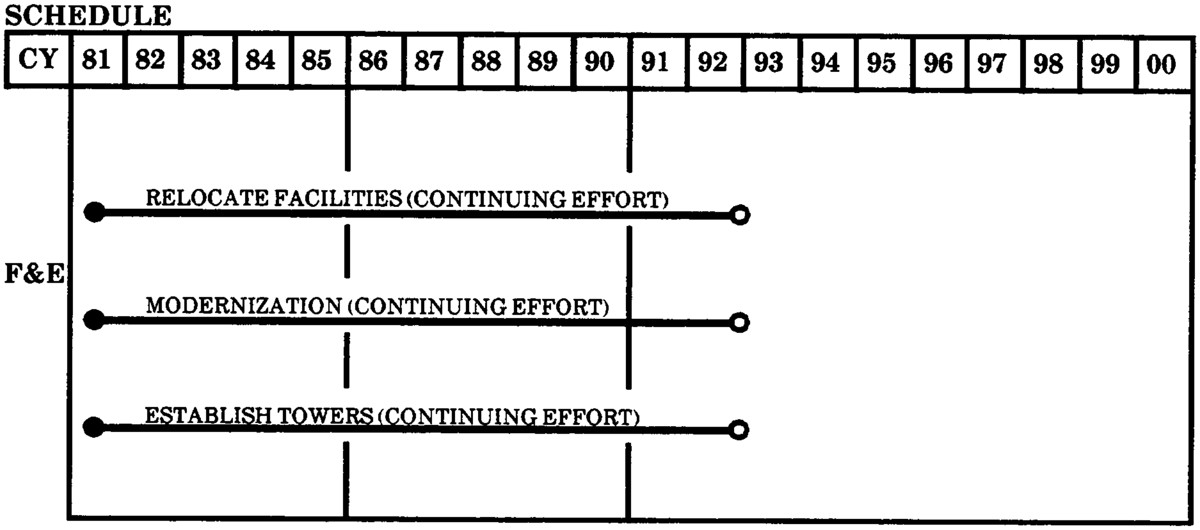
trative and training space, upgrade TRACABs to TRACONs; replace obsolete or unreliable engine generators and heating, ventilating, and air conditioning (HVAC) systems.

A number of existing facilities will surpass their 20 year design life prior to the year 2000. Thus, major costs will be incurred to replace or upgrade environmental systems and rehabilitate operational and administrative spaces.

Approach: FAA headquarters develops national standards and makes national environmental support buys. Construction will be by regional contracts supported by national architectural engineers for site-specific designs. This project does not include establishment or relocation of TRACON base a new tower or assumption of an existing facility. Approximately 20 facilities per year will require some level of major modernization and over 100 facilities per year will need some level of minor modernization; i.e., tower console, wind instruments, clocks, digital altimeter setting indicators, etc. In addition, seven mobile ATCTs will be acquired for basing within certain regions and the FAA Depot. These units will be used for spontaneous response to disasters, shutdowns, and events such as airshows and fly-ins at non-towered airports.

Related Projects/Activities: Area control facilities, tower position consoles, ICSS, NICS, and TCS. Continuing efforts beyond 1992 will be provided by the Sustained National Airspace System Support project in Chapter VII .

SCHEDULE

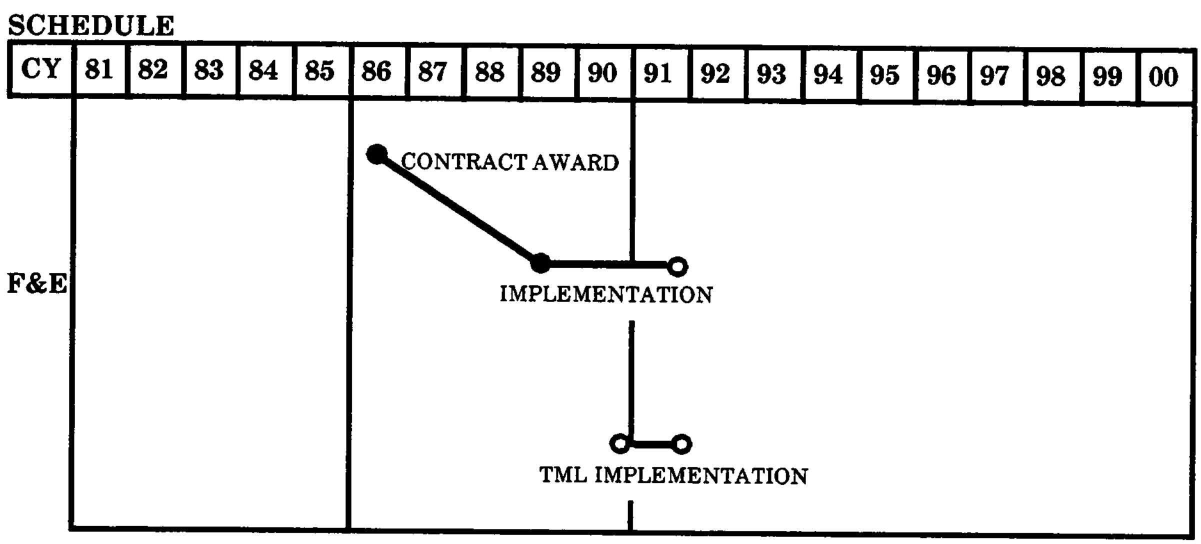


maintenance workload reductions will result.

Approach: Procure BRITE systems which take advantage of digital scan converter technology. This project will replace all BRITE and Bright Alphanumeric and Numeric Generator Conversion Equipment with the new system. The new system will also be installed at qualifying satellite towers providing

- Establish ASR/ATCT 9 Systems
- Establish Satellite ATCTs 40 Systems
- System Support 5 Systems

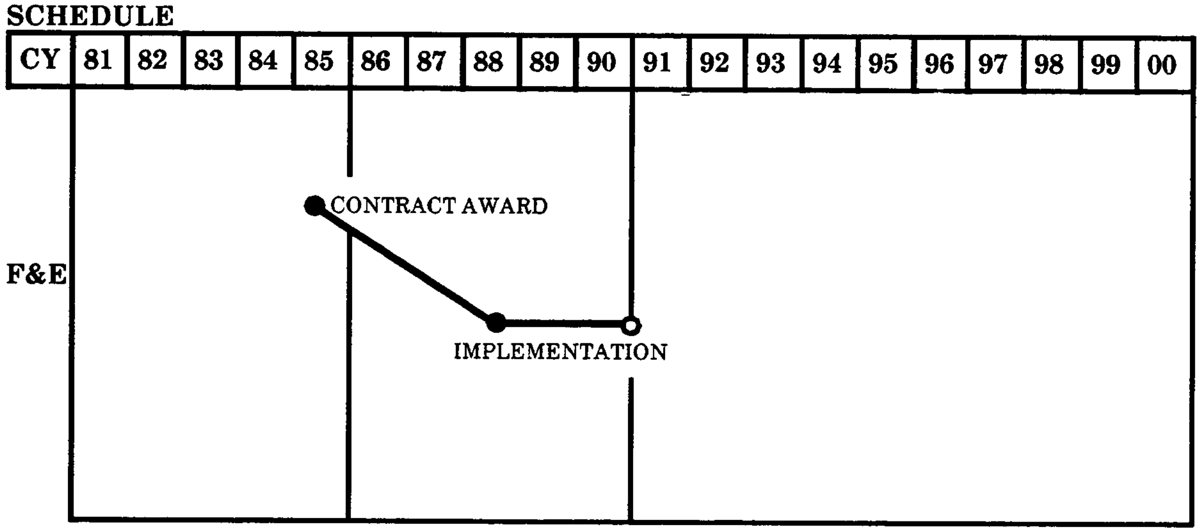
Related Projects/Activities: Data Multiplexing and TPX 42 replacement program. Frequency and spectrum engineering is required for the TML systems utilized in this project.



Approach: Procure 33 ARTS IIA systems, including displays. Displays procured for the TRACON

Related Projects/Activities: ARTS IIA, BRITE replacement program, and Data Multiplexing.

SCHEDULE

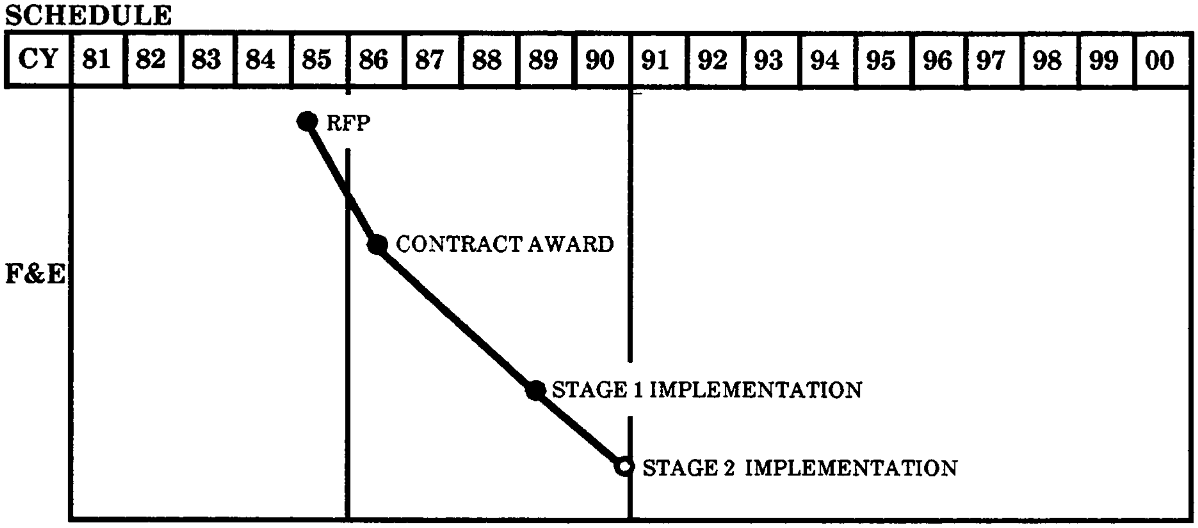


develop and implement a modified system architecture with appropriate hardware/ software changes to satisfy air traffic requirements until replacement.

Approach: Provide the necessary modifications and additional hardware/software to implement this project. An interim capacity upgrade portion of Stage 1, completed in June 1988, provided early modification, and/or additional processors, memory, intelligent displays, and software.

Related Projects/Activities: Enhanced Target Generator (ETG) Displays (ARTS III). The displays currently in use at the New York TRACON will be relocated to other ARTS III locations to provide needed training capability.

SCHEDULE



FLIGHT SERVICE AND WEATHER

FLIGHT SERVICE AND WEATHER SYSTEMS

In 1981 there were more than 300 FAA flight service stations (FSS) offering a broad range of preflight and in-flight services especially aimed at general aviation (or nonairline pilots). These services included:

- Accepting and closing flight plans.
- Conducting preflight weather briefings.
- En route communications with pilots flying under visual flight rules.
- Assisting pilots in distress.
- Disseminating aviation weather information.
- Monitoring air navigation radio aids.
- Originating notices to airmen.
- Working with search and rescue units in locating missing aircraft.

At certain locations, flight service stations take weather observations, issue airport advisories, provide en route flight advisory service, and advise customs and immigration officials of transborder flights. The stations also have communications equipment for relaying information to towers and air route traffic control centers for various emergency services.

Flight service stations range in size from very small facilities to large ones employing approximately 100 people. The buildings housing the stations vary in size, design, and age.

Of all the FSS services, none is more important to safety than those related to weather. The FAA aviation weather system collects weather information and distributes it to both pilots and FAA operational personnel. Weather information is collected largely with electromechanical devices that give wind velocity, temperature, dew point, ceiling, visibility, and altimeter settings. Facsimile weather maps and medium speed collection/display equipment are used.

FAA long-range surveillance radars are also used to give two levels of contours to outline weather on en route radar displays for controllers and for center weather service unit (CWSU) meteorologists at the en route centers. Other aviation weather information comes from the National Weather Service; Aeronautical Radio, Incorporated (ARINC); pilot reports; and observations made by agency personnel.

To get weather information to pilots, the FAA depends on telephones and radio voice broadcasts, including advisories made over VOR radio stations used for navigation. At some locations, voice recordings disseminate mass weather information. For some preflight briefings and in-flight advisories, direct communications between the pilot and flight service station specialist are used.

All of these functions continue to be performed similarly today. Flight and weather services provided federally, locally, or by the private sector are critical to the safety of today's system.

THE NEW APPROACH

Flight and weather services will be improved for pilots by giving them direct access to weather information and flight delay information, both in the air and on the ground, and simplifying flight plan filing. Aviation weather service is being improved in quality and timeliness, thus improving safety and saving fuel.

Automation and improvement of flight service stations and related aviation weather systems are being made to allow consolidation of facilities, reducing operating costs significantly. Automation of weather radar and current weather information is continuing and will provide more usable and current information to en route and terminal controllers and flight service station specialists.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

In the interval between 1981 and 1985, the process of consolidating existing flight service stations and the implementation of automated flight service was begun. During this initial effort, considerable progress was also made in the acquisition of improved weather information, the development of improved dissemination techniques, the definition of weather-related automation requirements, the development of automated flight services, and the selection of locations for automated flight service stations.

The existing national network of FAA and National Weather Service radars was retrofitted so that six levels of weather contouring, outlining storms, are now displayed to en route meteorologists at air route traffic control centers and flight service specialists at flight service stations. Satellite-originated weather images providing additional information on cloud cover and weather systems were provided to some of these locations through the implementation of facsimile recorders.

Other weather systems implemented include low level wind shear alert (LLWAS) equipment, which detects hazardous wind conditions. LLWAS was provided to initial airports. Research has determined that the number of wind sensors associated with this system should be increased to enhance performance.

The demonstration of automated weather observing systems (AWOS) was completed. These systems provide efficient and low-cost surface observation data critical to airport operations. Specification of the production system was completed.

Improvements in flight and weather information dissemination techniques were underway. Limited direct access to flight services was provided to pilots through the implementation of a computer-generated interim voice response system (IVRS). This system was implemented in 1985 and permits pilots on the ground to retrieve information, via telephone, from an automated weather data base.

The concept of broadcasting prerecorded hazardous in-flight weather advisories (HIWAS) over VORs was demonstrated and the acquisition process for a nationwide capability was completed. The dissemination of weather information from the flight service specialist to the en route pilot will also be improved. Equipment has been purchased which establishes a clear voice communication channel at 18,000 feet and above. This enhancement in en route flight advisory service (EFAS) will also be used for pilot reports.

The acquisition of automation aids for flight service specialists was well into production. The selection of 60 locations for automated flight service stations was accomplished.

The deployment of an enhanced international and domestic notice to airmen (NOTAM) system was completed. Development of the architectural elements which comprise the weather processing capabilities of the future was started. New processors will enhance the information available to air route traffic control center meteorologists and to all system users.

The requirements were defined for a data link processor which supports the transmission of weather products via Mode S data link.

Other improvements to the flight service system included the procurement of new communications switching systems and the replacement of all teletypewriter equipment.

NEAR TERM (TO 1990)

During the near term, the majority of on-going planned improvements previously described will be well underway.

Many of the 61 fully automated flight service stations will be in service. Additionally, all low level wind shear alert systems will be in operation. Additional sensors and improved algorithms will be added to the LLWAS, as appropriate, to improve detection of wind shear.

The AWOS program, beyond the initial FAA procurement of 160 commercial systems for immediate needs, will utilize automated surface observing system (ASOS) units that will be procured, installed, and maintained by the National Weather Service for the FAA. Most of the 160 commercial automated weather observing systems will be implemented at nontowered airports. Data from these systems will be supplied both to air traffic control system personnel and synthesized into voice messages for broadcast. After initial procurement, remaining units will be procured via a contract issued by the National Weather Service.

AWOS broadcasts will complement other improved services such as hazardous in-flight weather advisories (HIWAS) and the enhanced en route flight advisory service (EFAS). HIWAS was completed in 1989. EFAS outlets will be installed.

All of the 39 initial Model 1 flight service stations have been completed. Model 1 Full Capacity systems will be implemented at additional locations. Conversion of Model 1 to full capacity will begin. The Direct User Access Terminal (DUAT) service will be implemented, thus allowing flight service stations to become more responsive and effective.

The integrated communications switching system (ICSS) installation will be nearly complete. Its capabilities include automatic call distribution, telephone answering, and recording of flight plans.

The specification for replacement of the weather message switching center (WMSC), the gateway to National Meteorological Center (NMC) products, was completed. Contract Award occurred in 1988. WMSC replacements will distribute NMC alphanumeric and graphics products throughout the NAS. FAA-gathered weather data such as that generated by AWOS will be available.

A leased meteorologist weather processor (MWP) will be implemented for CWSU meteorologists and flow control applications. Development of a prototype real-time weather processor (RWP) which supports the unique weather product requirements of the NAS will be well underway.

The first data link processors (DLPs) will be implemented. Implementation of initial DLP services will be time phased to coincide with the deployment of the Mode S data link, and other elements of the weather information system. Aircraft, operating within Mode S coverage, will be able to acquire various types of weather and flight advisory information automatically as they become suitably equipped.

LONG TERM (TO 2000)

The National Weather Service (NWS) will provide automated surface observing systems at both towered and nontowered airports. All flight service automation systems (FSASs) will be completed and additional EFAS outlets may be installed.

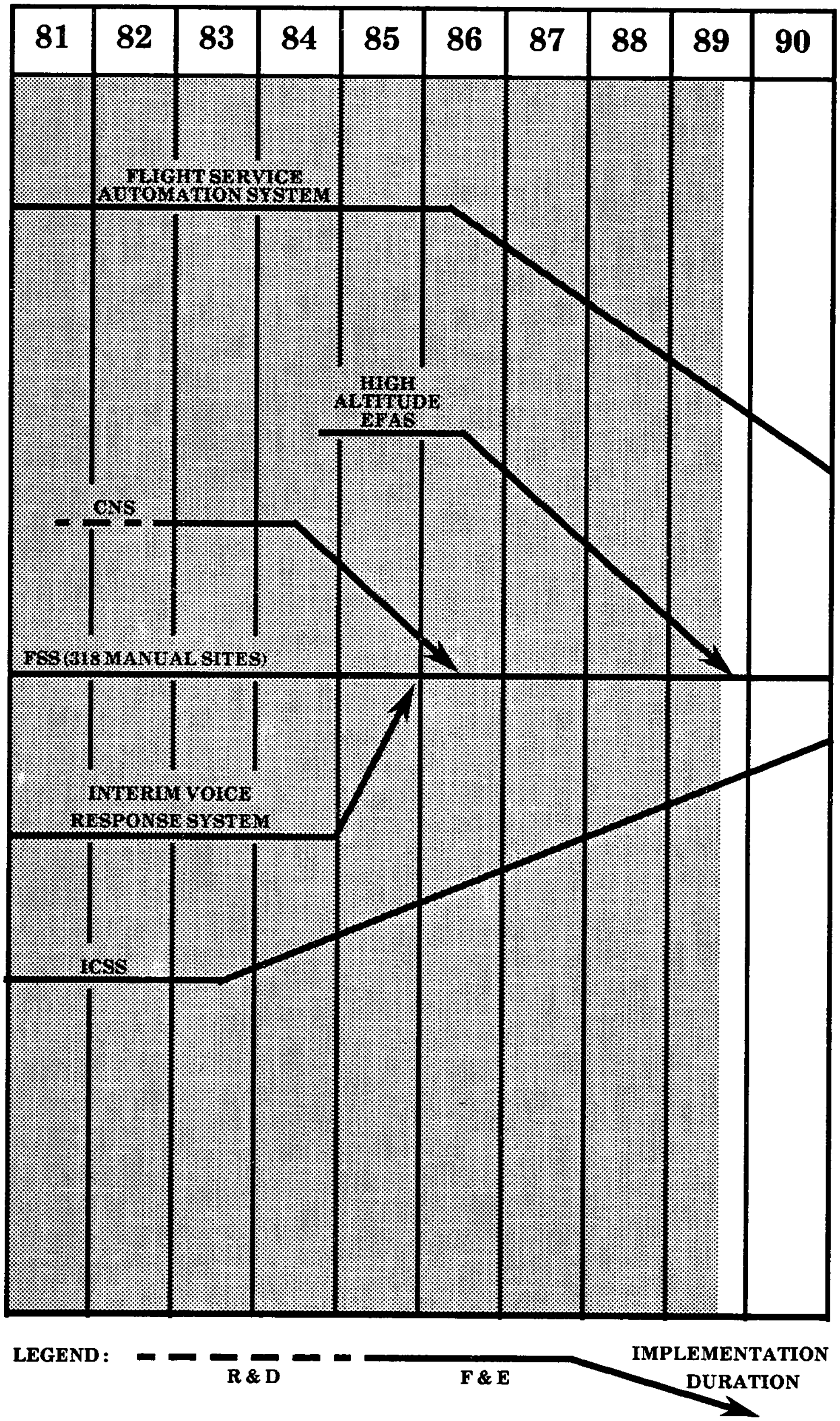
The Weather Message Switching Centers will be replaced with state-of-the-art equipment and real-time weather processors will be implemented.

A modernized system of flight services and weather services will have evolved. Users will have ready access to the required weather and flight information during all phases of flight operation. Access to preflight information will be accomplished via telephone to either flight service station specialists, the voice response system, or direct user access terminals. Access to in-flight information will be accomplished via radio to EFAS, via automatically updated continuous broadcasts, via the Mode S data link, and from specialists and controllers on an as-required basis.

A network of Doppler weather radars will be completed. This, in conjunction with ASR 9 and conventional radars, will improve the weather radar data base for real-time automated air traffic control functions. FAA-funded AWOS/ASOS, in combination with the weather service owned automated surface observing system, will form the nationwide surface observation network. Satellite imagery information will continue to be used to provide weather information to flight service station specialists. Mode S data link coverage will be provided down to 6,000 feet altitude above mean sea level, providing automated service to aircraft at lower altitudes.

Improvements in wind shear detection using terminal Doppler radar will be implemented. Programs based on current research to determine the effects that wind, wind gradient, turbulence factor, temperature, temperature gradient, pressure, and humidity have on the generation, transport, and decay of wake vortices may result in the solution of wake vortex hazards. Improved information regarding rates of falling rain, sleet, snow, cloud heights, and lightning detectors for thunderstorm location may be provided.

The following diagrams and maps describe the evolution of the system.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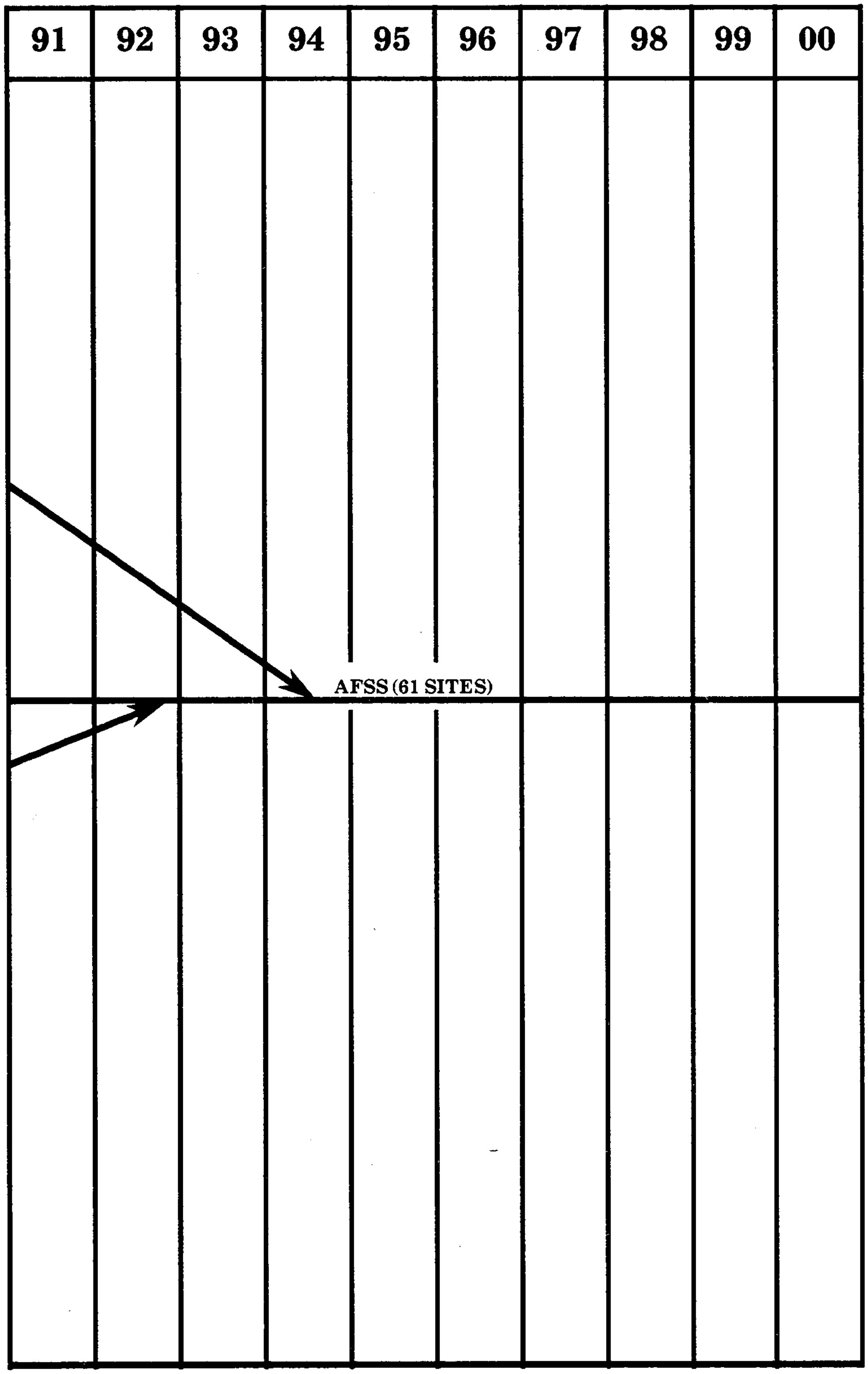
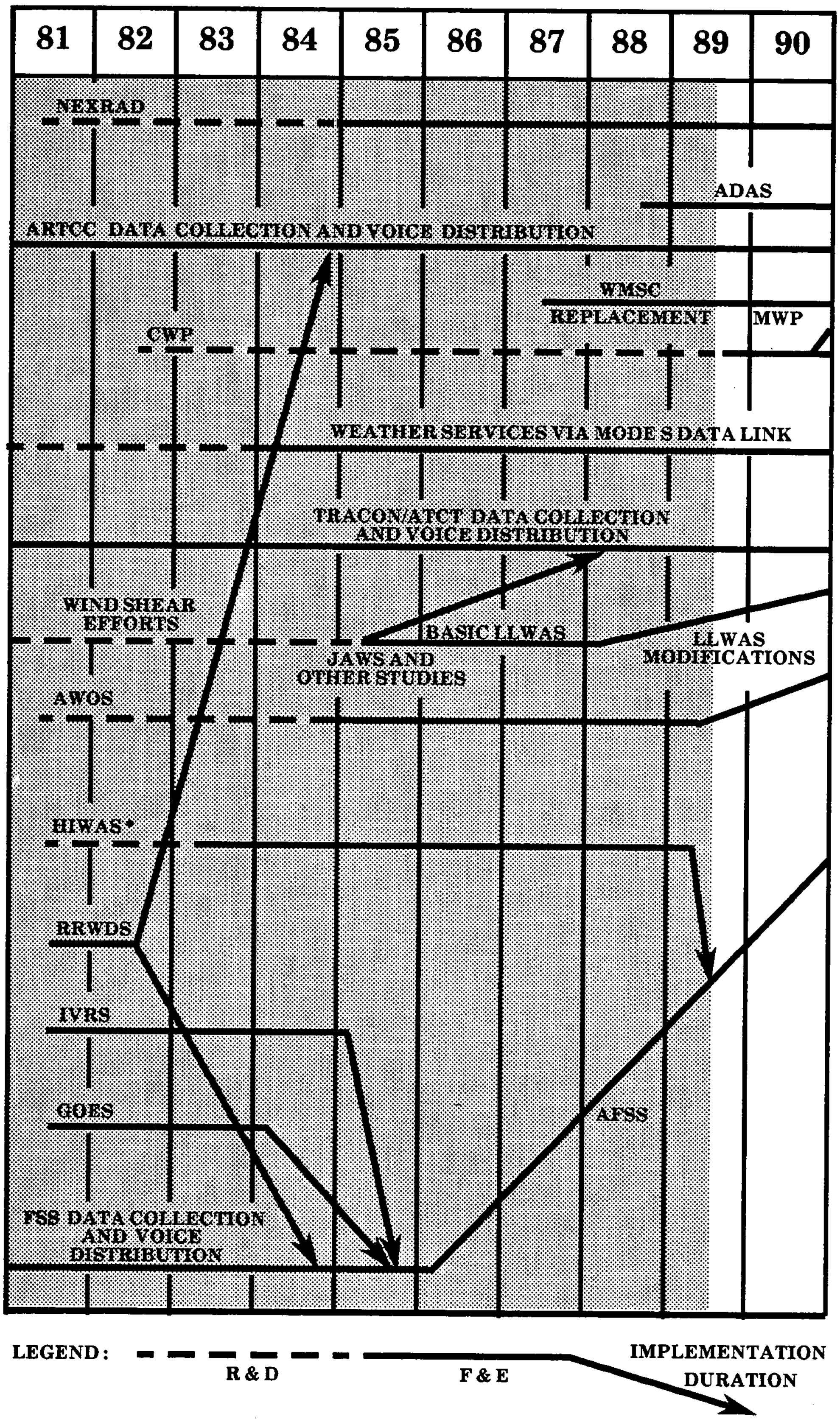
FLIGHT SERVICE AUTOMATION SYSTEM
HIGH ALTITUDE EFAS
CNS
FSS (318 MANUAL SITES)
INTERIM VOICE RESPONSE SYSTEM
ICSS
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



FLIGHT SERVICE SYSTEMS EVOLUTION



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NEXRAD
ADAS
ARTCC DATA COLLECTION AND VOICE DISTRIBUTION
WMSC
REPLACEMENT
MWP
CWP
WEATHER SERVICES VIA MODE S DATA LINK
TRACON/ATCT DATA COLLECTION
AND VOICE DISTRIBUTION
WIND SHEAR
EFFORTS
BASIC LLWAS
LLWAS
MODIFICATIONS
JAWS AND
OTHER STUDIES
AWOS
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AND VOICE
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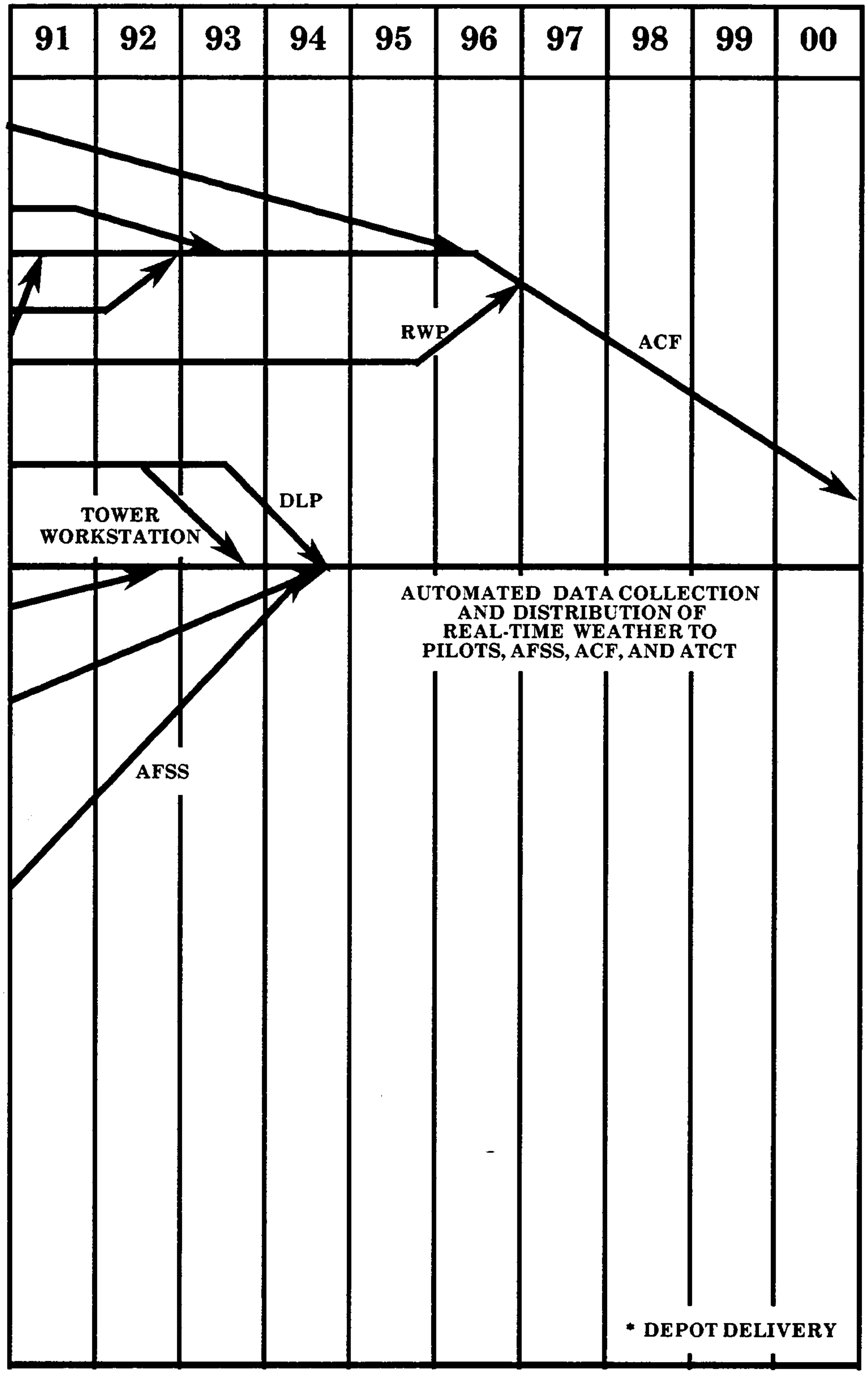
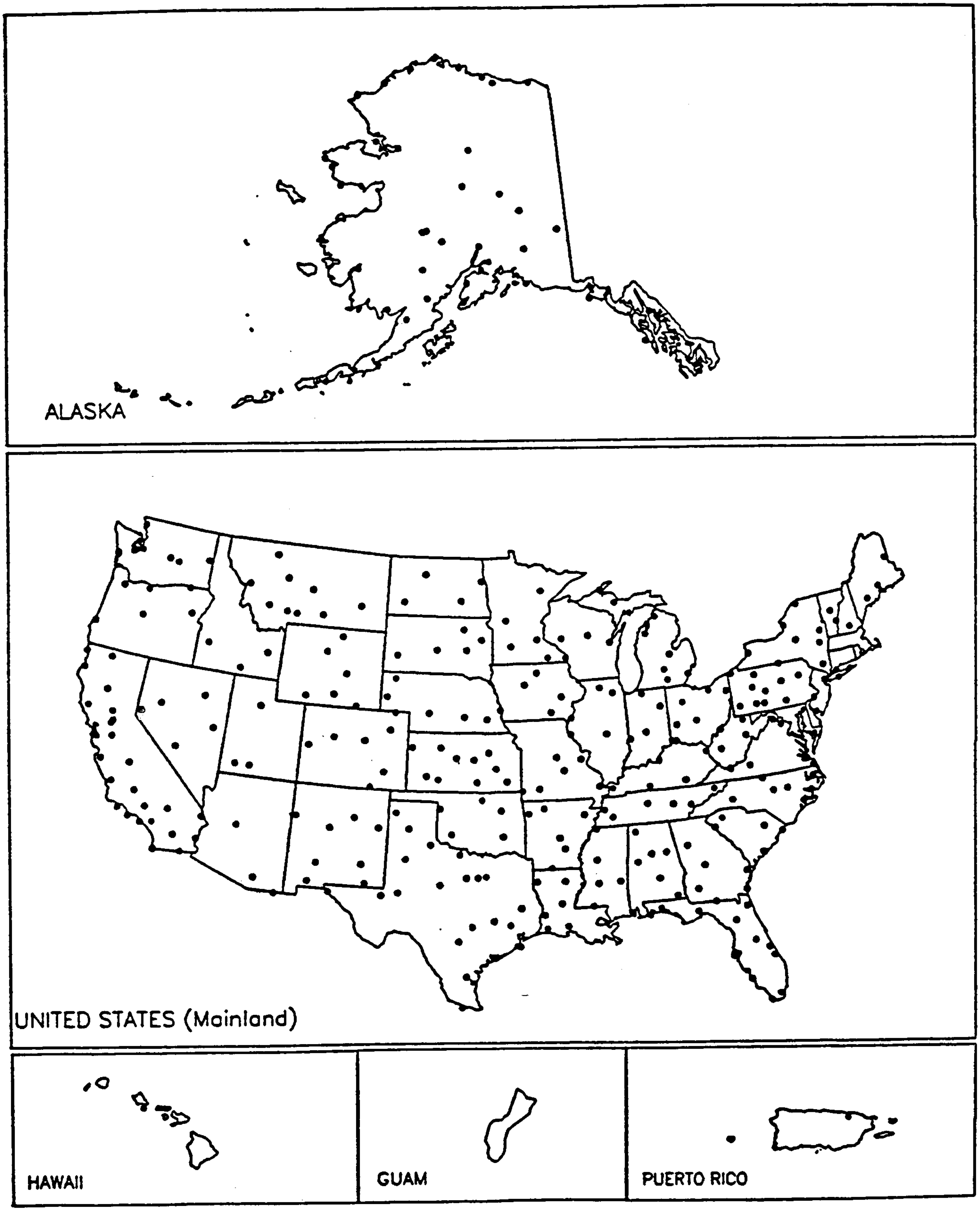
IMPLEMENTATION
DURATION



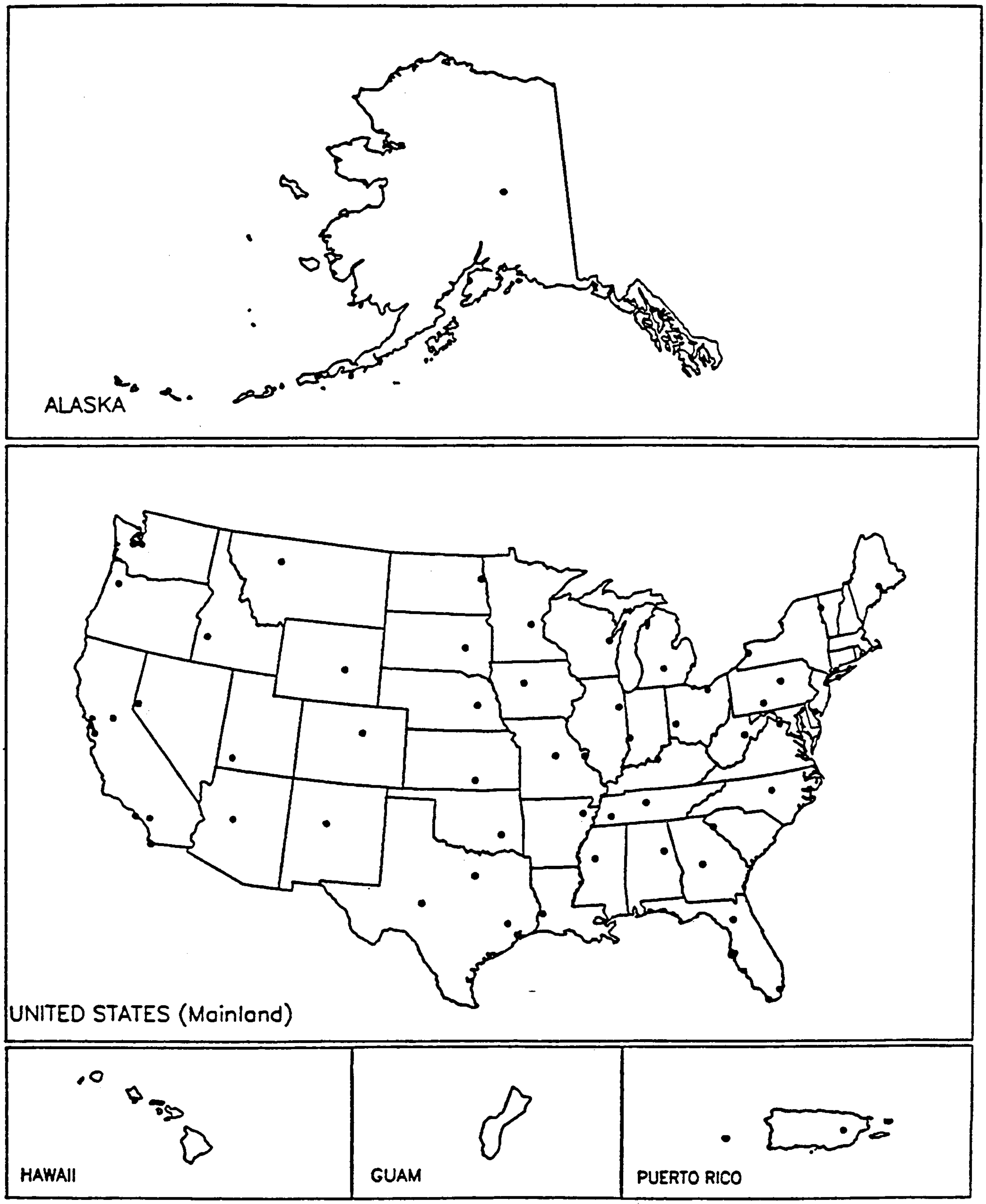
WEATHER SYSTEMS EVOLUTION

AUTOMATION OF FLIGHT SERVICE STATIONS AND FACILITY CONSOLIDATION IS UNDERWAY. 60 LOCATIONS HAVE BEEN SELECTED TO DATE.



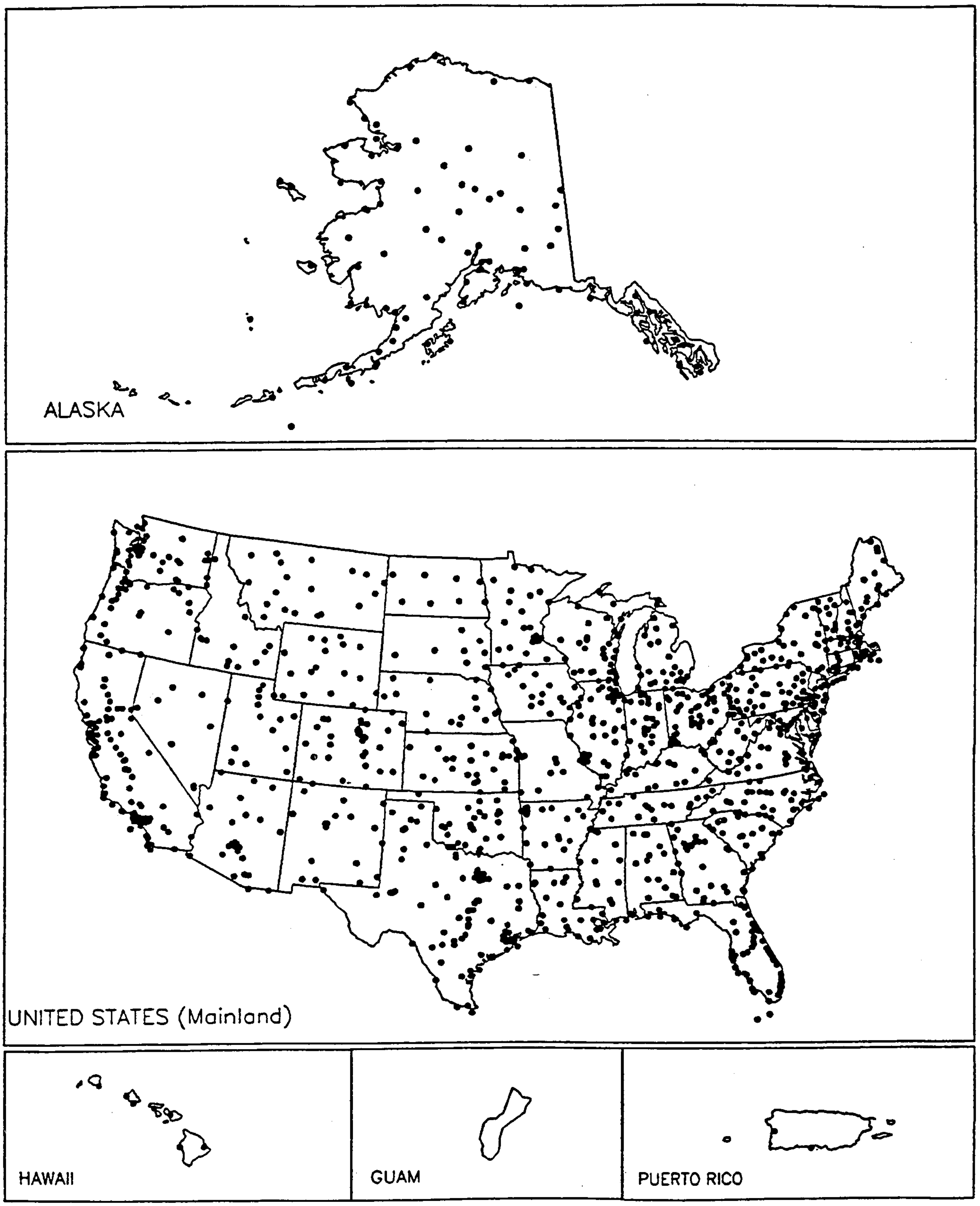
1985 SYSTEM
FLIGHT SERVICE STATIONS

BY 1994, AUTOMATION AND FACILITY CONSOLIDATION WILL RESULT IN 61 MODEL 1 FULL CAPACITY AUTOMATED FLIGHT SERVICE STATIONS DRIVEN BY 23 FSDPSs.



1990 - 2000 SYSTEM
FLIGHT SERVICE STATIONS

BY THE YEAR 2000, AUTOMATED WEATHER OBSERVING SYSTEMS OR AUTOMATED SURFACE OBSERVING SYSTEMS WILL BE ESTABLISHED FOR 304 TOWERED AND UP TO 437 NONTOWERED AIRPORTS. ADDITIONALLY, 400 NON-TOWERED AIRPORTS ARE EXPECTED TO INSTALL AUTOMATED WEATHER OBSERVING SYSTEMS WITH AIP FUNDS. WEATHER DATA WILL BE TRANSMITTED TO PILOTS OVER VHF/UHF COMMUNICATIONS OUTLETS, VIA MODE S DATA LINK, VIA TELEPHONE, AND AS PART OF THE ATIS MESSAGE. IN ADDITION, IT WILL BE PROVIDED TO CONTROLLERS AND THE WEATHER NETWORK OVER THE FAA TELECOMMUNICATIONS NETWORK.



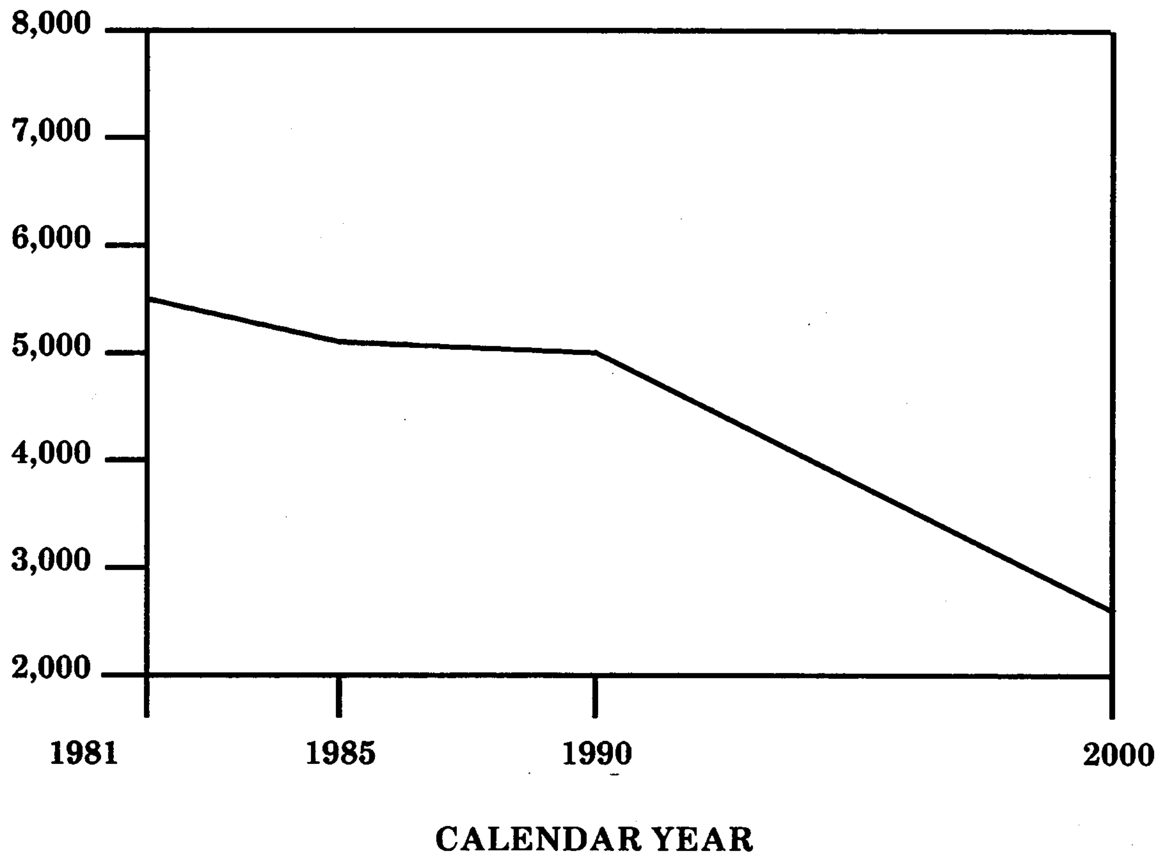
1990 - 2000 SYSTEM
AUTOMATED WEATHER OBSERVING SYSTEM

RETURN ON THE INVESTMENT

As a result of these planned actions, FAA operational costs will be significantly reduced; productivity will increase; and, most important, FAA's service to the user will be substantially improved.

FAA FIELD EMPLOYMENT

By the year 2000, these changes will result in decreases of 41 percent in Airway Facilities personnel requirements and 54 percent in Air Traffic personnel requirements from the 1981 levels. Estimates of Air Traffic employment in the year 2000 are based upon new studies which indicate that 70 percent of the demand for FSS services will be accommodated by the automated systems. Previous years' estimates were based on automated systems accommodating 90 percent of demand.



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(FLIGHT SERVICE STATIONS)

SUMMARY OF FACILITY CHANGES

1981 – Airway Facilities and Air Traffic employment for 979 facilities required a total of 5,487 people.

1985 – Air Traffic employment decreased to 4,553 due to the interim voice response system and the consolidation of manual flight service stations into automated stations. Airway Facilities staffing has decreased due to these consolidations and the conversion to solid-state equipment.

1990 – Airway Facilities employment will decrease due to facility consolidation.

2000 – Decreases in Air Traffic staffing will occur due to the widespread acceptance of automated flight services. Despite the expansion of weather systems there will be a small decrease in Airway Facilities staffing. A total field work force of 2,642 will be required to operate and support FSS/weather facilities.

Outyear estimates are reviewed annually and are subject to revision.

FLIGHT SERVICE SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES
AND CORRESPONDING PERSONNEL COSTS
(1981 Dollars)

	1981	1985	1990	2000
Operations (Millions)	62.6	52.9	44.2	48.2
Air Traffic Personnel	4,671	4,553	4,400	2,161
AT Productivity Quotient	13,402	11,619	10,045	22,304
Airway Facilities Personnel	816	625	516	481
AF Productivity Quotient	76,716	84,640	85,659	100,208
Total AT and AF Staffing	5,487	5,178	4,916	2,642
Air Traffic Personnel Costs (thousands)	$127,051	$123,842	119,680	58,779
Airway Facilities Personnel Costs (thousands)	$27,826	$21,313	$17,596	$16,402

PROGRAM RELATIONSHIPS

The current National Airspace System is limited in its ability to support the provision of flight services and rapidly acquire, process, and disseminate accurate weather data and operationally significant information to both flight service and air traffic control system users. The projects in this chapter provide the foundation for evolutionary improvements. These areas are grouped into four basic improvement categories: automation, mass weather dissemination, surveillance, and communications. In combination with initiatives contained in other chapters (processing improvements obtained through advanced automation system (AAS) and traffic management system (TMS), data acquisition improvements obtained through the airport surveillance radar (ASR 9) weather channel, next generation weather radar (NEXRAD), and data dissemination improvements obtained through national airspace data interchange network (NADIN) and Mode S data link they form the architecture required to reduce the risk of weather-related accidents and reduce the costs associated with weather-related delays.

Automation improvements provide information processing capabilities which increase system safety and FAA operational productivity, in keeping with the demand for timely and accurate weather information and service. System improvements include: the capability to meet the projected increases in demand for flight services without a proportional increase in staff and operational costs, the enhancement of real-time processing of hazardous weather data for air traffic control, the simplification of the storage and forwarding of data from sources to users, the upgrade in notice to airmen (NOTAM) processing and distribution, and the establishment of data link access to computer-based weather information from various sources.

Mass weather dissemination enhancements in this chapter provide near-term improvements in the availability and efficiency of on-the-ground (IVRS) and in-the-air routine (EFAS) and hazardous (HIWAS) meteorological and other information. These supplement the flight service station and air traffic control system capabilities, such as automatic terminal information service (ATIS), which are described in other chapters. The implementation of an improved communications channel, such as EFAS, through the addition of new frequencies, also reduces frequency congestion problems. Techniques which allow for direct access to weather data increase the air traffic controller's and the flight service station specialist's productivity by freeing them from routine labor-intensive tasks. The near-term improvements provided by projects in this chapter may be viewed as evolutionary steps toward the programwide objective of a more timely and less labor-intensive system.

The surveillance improvement projects included in this chapter provide for the detection and display of more accurate, reliable, and complete meteorological information critical to FAA controllers, flight service specialists, and aviation users. In combination with the longer-term projects described in other chapters; e.g., NEXRAD, they will reduce the adverse impact of weather phenomenon by providing timely warning of such hazardous weather conditions as thunderstorms, turbulence, and wind shear.

Communications improvement focuses on the establishment of an economical integrated communications switching system which will ensure affordable ground-to-ground voice communications for the network of flight service stations and the terminal portion of the air traffic control system. This improvement, combined with improvements in other chapters, e.g., voice switching and control system (VSCS) for en route air traffic control and all projects in Chapter V, Interfacility Communications Systems, is an evolutionary step toward the programmatic objective of controlled leased services costs.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
AUTOMATION		
1. Flight Service Automation System (FSAS)	1986	1994
2. Central Weather Processor (CWP)	1990	1996
3. Consolidated NOTAM System (CNS)	PROJECT COMPLETE	1986
4. Weather Message Switching Center (WMSC) Replacement	1992	1992
5. Aeronautical Data Link (Previously Weather Communications Processor/Data Link)	1992	1994
MASS WEATHER DISSEMINATION		
6. Interim Voice Response System (IVRS)	PROJECT COMPLETE	1985
7. High-Altitude En Route Flight Advisory Service (EFAS) Frequencies	1986	1989
8. Hazardous In-Flight Weather Advisory Service (HIWAS)*	PROJECT COMPLETE	1989
SURVEILLANCE		
9. Automated Weather Observing System (AWOS)	1989	1994
10. Radar Remote Weather Display System (RRWDS)	PROJECT COMPLETE	1984
11. Geostationary Operational Environmental Satellite (GOES) Recorders	PROJECT COMPLETE	1985
12. Low Level Wind Shear Alert System (LLWAS)	1985	1992
COMMUNICATIONS		
13. Integrated Communications Switching System (ICSS)	1983	1992

* Depot Delivery Dates

PROJECT SUMMARY

PROJECT 1: Flight Service Automation System (FSAS)

Purpose: This project will improve user access to weather information and NOTAMs, simplify flight plan filing, and provide a flight service station automation system that will meet the projected increases in demand for flight services without proportional increases in staff.

Approach: Development and implementation of automation for flight service stations will be phased. The first Model 1 system was commissioned in February 1986, and the last Model 1 will be commissioned in 1989.

The Model 1 Full Capacity system will build upon the base provided by the Model 1 design. This system will provide additional hardware (including two aviation weather processors) and the necessary software to increase processing capacity to allow completion of FSS consolidation. During Model 1 Full Capacity implementation, all Model 1 systems will be converted to Model 1 Full Capacity systems. In addition, Model 1 Full Capacity systems will be provided to the remainder of the AFSS and FSDPS facilities.

The direct user access terminal (DUAT) service will be implemented to improve user access to weather information and flight plan filing. This service will be leased from commercial vendors to meet a schedule compatible with system installations.

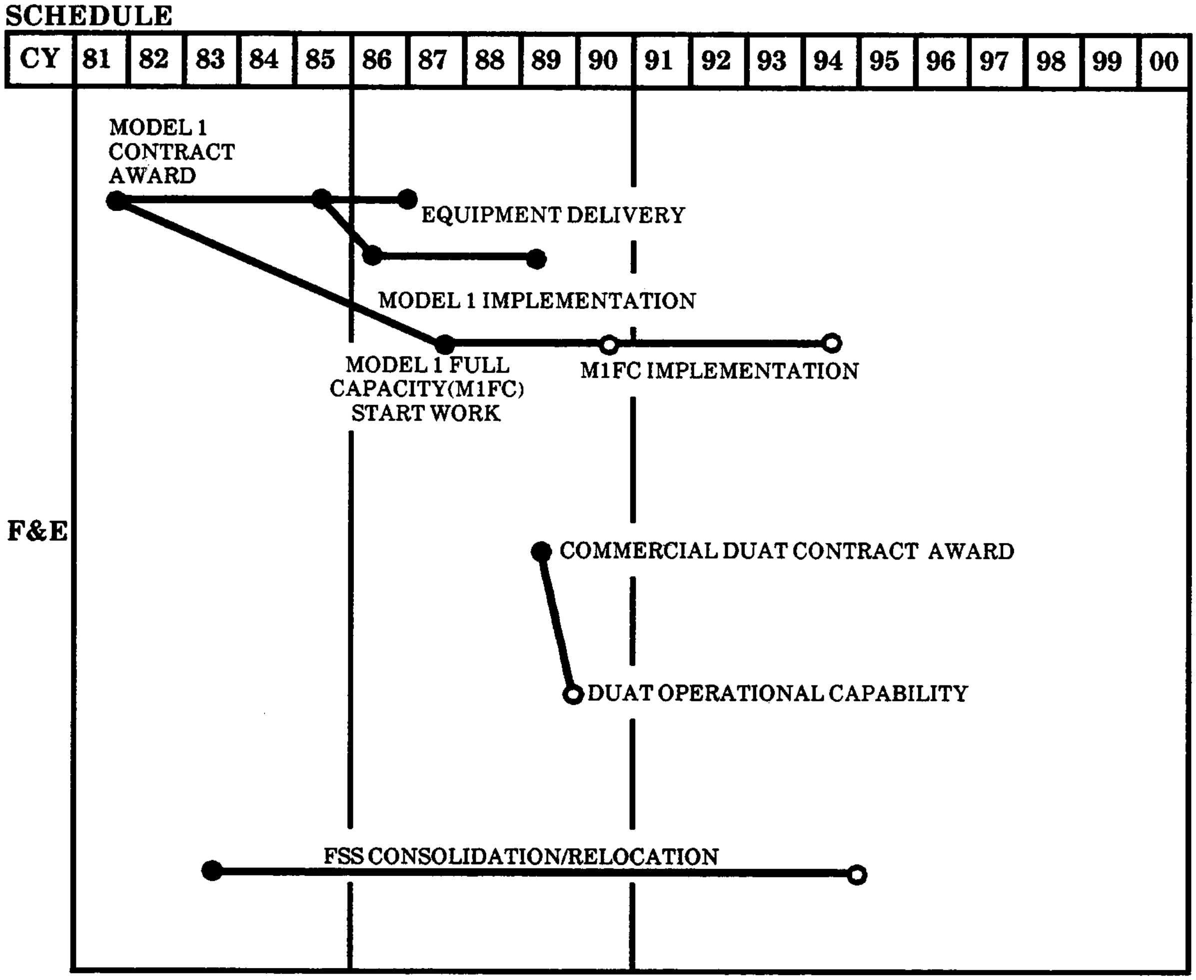
Thirty-nine automated flight service stations will be commissioned through 1989. All 61 automated flight service stations will be commissioned by 1994.

Products:

- Model 1.
  - 13 flight service data processing systems (at ARTCCs).
  - 39 FSSs equipped with automation position equipment.
- Model 1 Full Capacity.
  - 2 aviation weather processors (at NADIN switching centers).
  - 21 operational flight service data processing systems.
  - 61 automated flight service stations.

Related Projects/Activities: Flight service facilities space for most of the 61 automated flight service stations will be acquired on a sponsor-provided leased basis at selected airports. The 61 new facilities will house FSAS specialist automation positions and the other equipment necessary to satisfy FSS system requirements. The ICSS, AAS, DF modernization, WMSC Replacement, TMS, and CNS will support enhanced flight services. This program will require interfacility communications service from NADIN. The FSAS will interface with RMMS.

SCHEDULE



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MODEL 1 IMPLEMENTATION
MODEL 1 FULL CAPACITY(M1FC) START WORK
M1FC IMPLEMENTATION
COMMERCIAL DUAT CONTRACT AWARD
DUAT OPERATIONAL CAPABILITY
FSS CONSOLIDATION/RELOCATION

PROJECT 2: Central Weather Processor (CWP)

Purpose: This project will improve the collection, synthesis, and dissemination of weather information throughout the National Airspace System to pilots, controllers, traffic management specialists/coordinators, and meteorologists. This project provides the center weather service unit/central flow weather service unit (CWSU/CFWSU) meteorologists with automated work stations which greatly enhance their ability to analyze rapidly changing, potentially hazardous weather conditions, and ensures that the latest and best information is provided to all system users. It also provides for a mosaic display of multiple weather radars. These improvements are deemed necessary to reduce accidents and air traffic delays directly related to weather.

Approach: The Central Weather Processor project is composed of two elements. The first is a commercially-available Meteorologist Weather Processor (MWP) which will be procured through a series of leases starting in the near term. The MWP will provide modern automation support to the weather analysis and forecasting functions of the CWSU in each ARTCC/ACF. An identical Central Flow MWP (CFMWP) will support the CFWSU in the central flow control function (CFCF). The second element is a Real-time Weather Processor (RWP) in each ARTCC/ACF which will create unique weather products required by the NAS and provide the NAS unique interfaces.

The MWP will be a computer-based, interactive meteorological data processing service. The MWP used in the second lease period will interface with the NWS Warning and Forecast Offices, WMSC Replacement, Maintenance Processing Subsystem (MPS), and the RWP. The feasibility of using a version of the NWS AWIPS 90 workstation starting in the second lease period will be determined through a joint FAA/NWS effort.

The RWP will mosaic data from multiple NEXRAD radars and provide these products and other time-critical and operationally significant weather information for use by air traffic controllers via the AAS. The RWP will also transmit a subset of its weather products to the data link processor (DLP) for uplink to pilots via the Mode S data link. A contractor will develop operational RWP software on prototype hardware. The prototype RWP will undergo operational test and evaluation. After approval for production, turnkey systems will be procured. Software developed during the prototype phase will be government-furnished to the production contractor for field implementation.

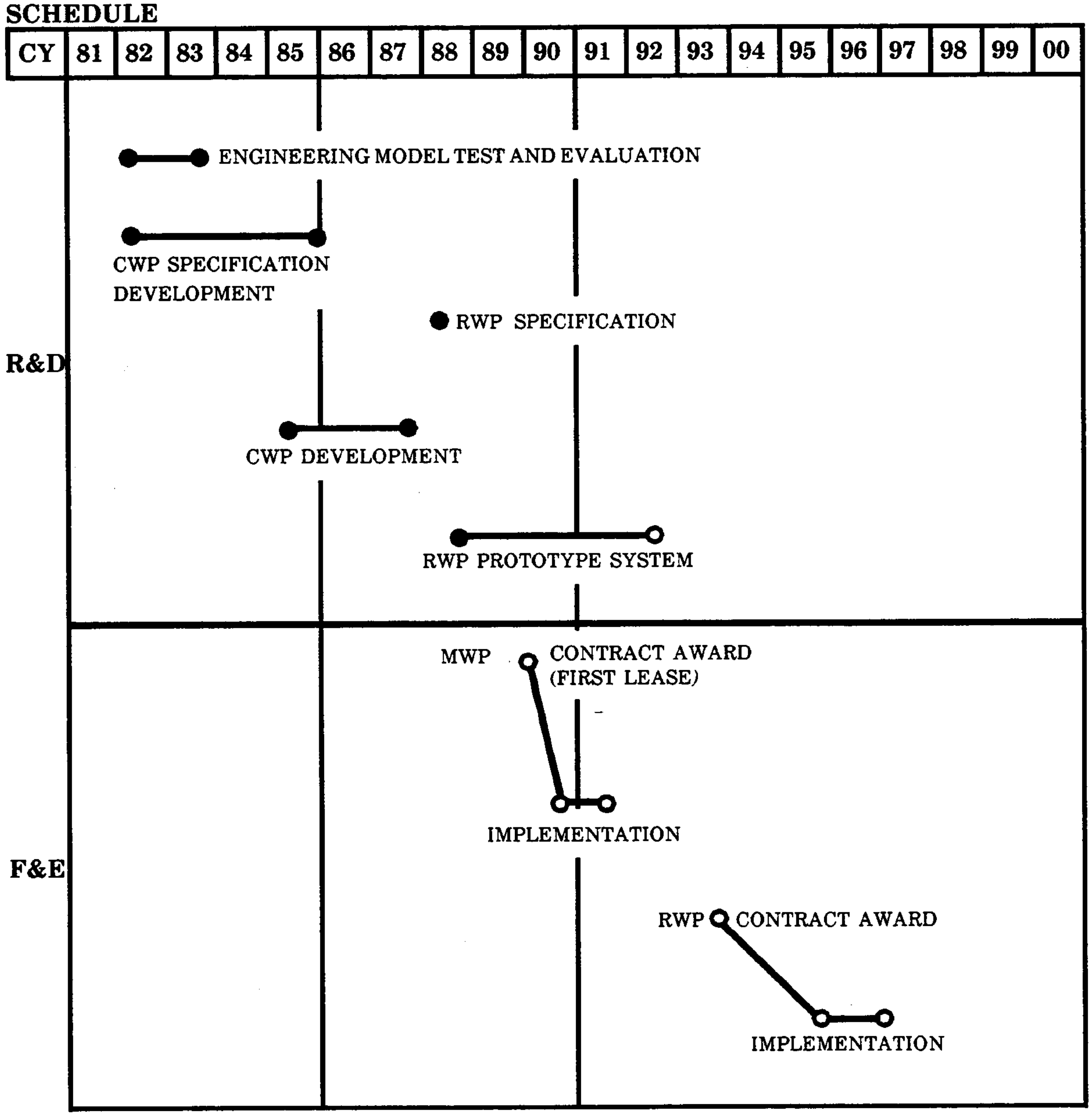
Products: MWP - The initial lease will provide 23 leased MWPs, including intrafacility traffic management and area supervisor briefing terminals. (21 MWPs to ARTCCs/ACFs and 2 CFMWPs to the CFCF). During the second lease period an additional MWP will be leased for the FAA Technical Center.

RWP - 24 production RWPs (22 to ACFs, 1 to the FAA Academy, and 1 to the FAA Technical Center).

Related Projects/Activities:

- NEXRAD – The CWP will receive periodic products and request/reply products from NEXRAD.
- WMSC Replacement – The CWP will exchange weather products with the WMSC Replacement.
- AAS – The RWP will send weather products to and receive PIREPs from the AAS.
- ADAS – The RWP will receive AWOS/ASOS data via the ADAS.
- RMMS – The CWP will interface with the maintenance processing subsystem (MPS) for status reporting.
- TMS – The CFMWP will provide displays for the traffic management specialists in the CFCF, and the MWP will provide them for the traffic coordinators in the ACF TMUs.
- ACF Data Link Services - The RWP will send graphic weather products to the DLP. The DLP will send PIREPs received via Mode S data link to the RWP.
- This project will require interfacility communications service from NICS. Projects providing that service include NADIN.

SCHEDULE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ENGINEERING MODEL TEST AND EVALUATION
CWP SPECIFICATION DEVELOPMENT
RWP SPECIFICATION
CWP DEVELOPMENT
RWP PROTOTYPE SYSTEM
F&E
MWP
CONTRACT AWARD (FIRST LEASE)
IMPLEMENTATION
RWP
CONTRACT AWARD
IMPLEMENTATION

PROJECT 4: Weather Message Switching Center (WMSC) Replacement

Purpose: This project will replace the weather message switching center with state-of-the-art equipment and technology to perform all current alphanumeric weather data handling functions of the WMSC, and the storage and distribution of NOTAMs. It will rely on NADIN packet switch network for a majority of communications support. Further, the system will accommodate graphic data, and function as the primary FAA gateway to the National Weather Service Telecommunications Gateway (NWSTG), which will be the source of National Weather Service products for the NAS.

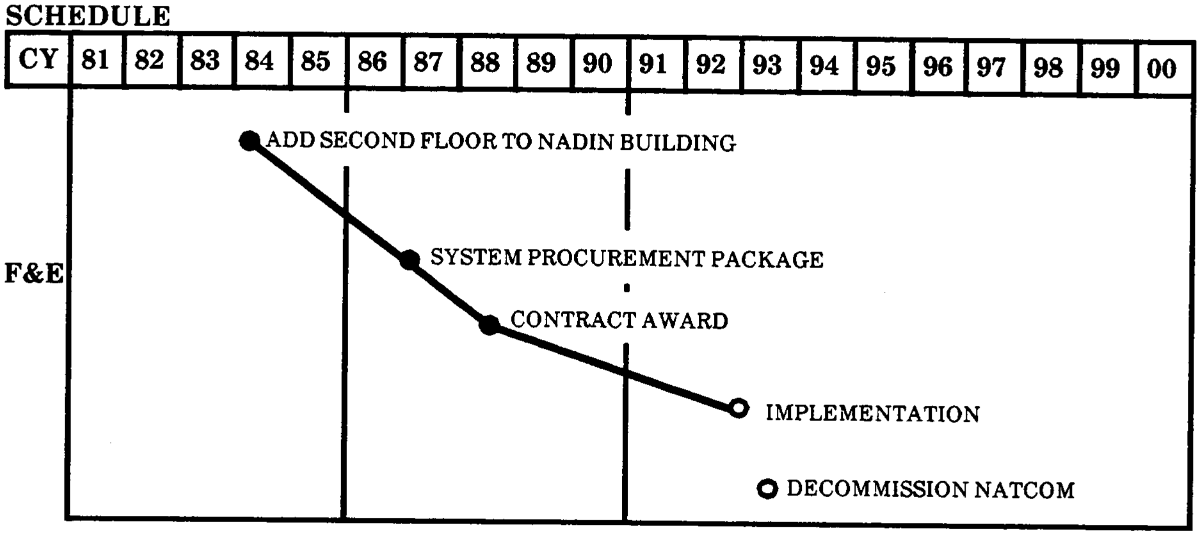
Approach: The system will be procured for turnkey installation. To provide geographic redundancy, the WMSC Replacement will have nodes located in the National Aviation Weather Processor (NAWP) facilities (Atlanta, GA, and Salt Lake City, UT, NADIN buildings). Each node will support approximately one-half of the United States and continuously exchange information with the other to ensure that both nodes have identical national data bases. In event of a nodal failure, the surviving node will assume responsibility for the entire network. The implementation of the WMSC Replacement will allow the closing of the National Communications Center (NATCOM). Upon closing, the NATCOM building will be refurbished for GSA.

Products: WMSC Replacement nodal processors and related peripherals to be located at each of the two NAWP facilities, and the NWSTG/WMSC Replacement interface device located at the Washington ARTCC.

Related Projects/Activities:

- FSAS – The WMSC Replacement will exchange alphanumeric weather data and NOTAMs with the Aviation Weather Processor (AWP).
- TMP - The WMSC Replacement will exchange weather products with the Traffic Management Processor.
- CWP – The WMSC Replacement will exchange weather products with the MWP and RWP.
- ADAS – The WMSC Replacement will route weather products from the ADAS to the NWSTG and other NAS users.
- DLP – The WMSC Replacement will transmit alphanumeric weather data to the Data Link Processor (DLP).
- CNS – The WMSC Replacement will store and distribute NOTAMs from CNS.
- NADIN – The WMSC Replacement will interface with the NADIN Packet Switch Network (PSN) which will provide the communications between the WMSC Replacement and its users.
- RMMS – The WMSC Replacement will interface with the maintenance processor subsystem for status reporting.

SCHEDULE



PROJECT 5: Aeronautical Data Link

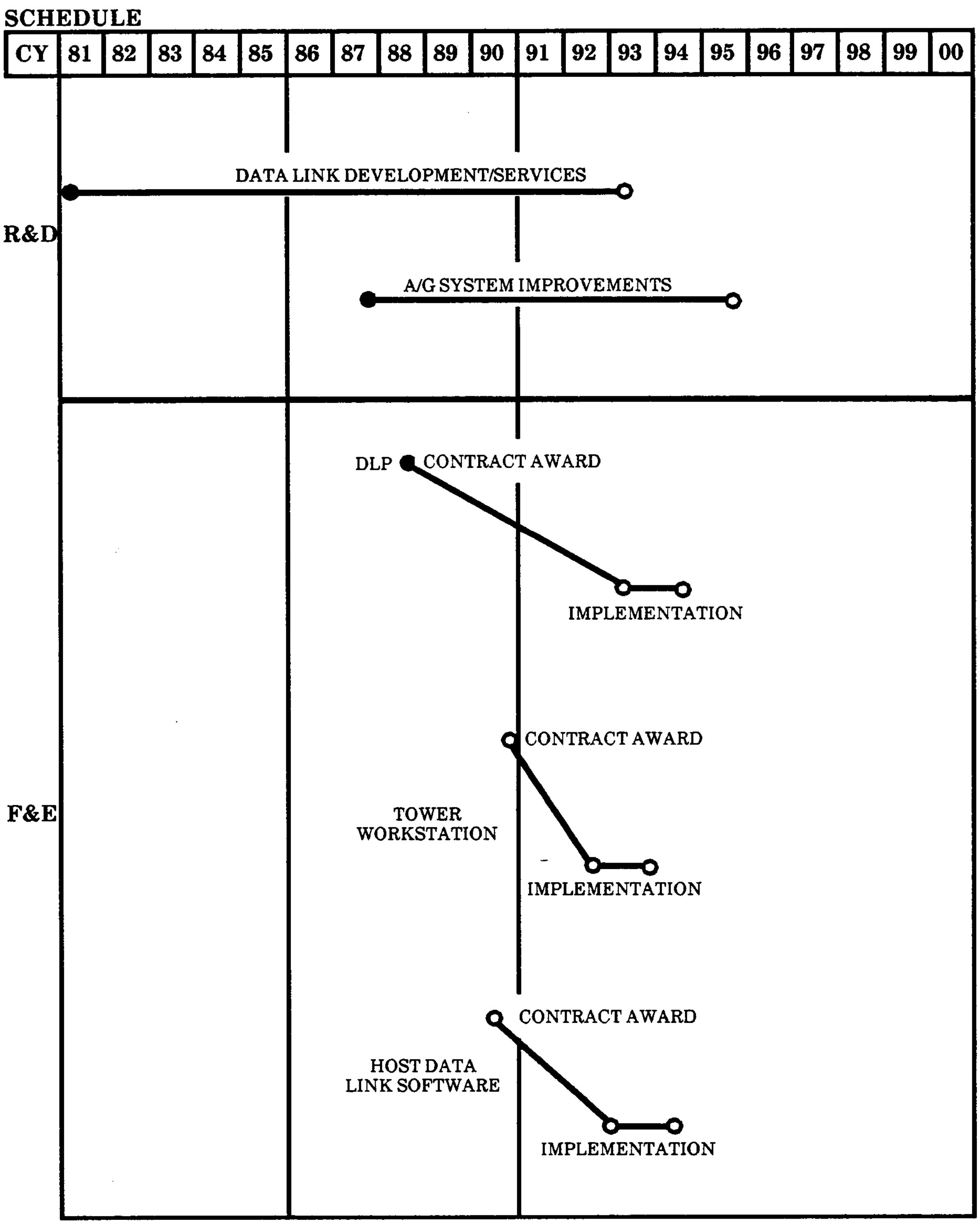
Purpose: This project (formerly called Weather Communications Processor/Data Link) will develop, evaluate, and implement a variety of weather and ATC data link services. Weather products such as surface observations, terminal forecasts, winds aloft forecasts, pilot reports, and hazardous weather advisories will be provided to pilots on a request/reply basis. ATC services such as altitude confirmation, transfer of communication, and en route minimum safe altitude warning will be provided on a ground-initiated basis when appropriate conditions exist within en route ATC automation. The availability of data link communications will improve air/ground communications and contribute to system safety and capacity by enhancing pilot accessibility to information, relieving congested voice frequencies, and reducing the workload of pilots, specialists, and controllers.

Approach: This project requires the construction of the communications architecture (air and ground) and the selection, development, and evaluation of candidate services. Three elements are involved: the Data Link Processor (DLP), the Tower Workstation, and Host enhancements. The initial (interim) DLP (formerly known as the Weather Communications Processor) will provide Mode S specific communication processing, message routing between applications processors and Mode S sensors, and weather application processing and associated end-to-end communication functions. As the system evolves, the DLP will be enhanced to function as the gateway connecting applications processors and the Mode S network with other air-ground networks. Also, requirements have been developed for an airborne DLP to perform corresponding communications functions in data link equipped aircraft. The Tower Workstation will accept automated and manually entered weather observations and airport information, and format ATIS messages for data link distribution via the DLP and synthesized voice radio broadcasts. Host software enhancements will provide ATC applications processing and associated end-to-end communication functions. Candidate data link services will be selected and prototypes will be subjected to technical and operational evaluation prior to field implementation.

Products: 24 DLPs - 22 for ARTCCs/ACFs, 1 to the FAA Academy, and 1 to the FAA Technical Center; 264 Tower Workstations - 1 to each of 258 future TCCCs, 3 to the FAA Academy, and 3 to the FAA Technical Center; Host software enhancements for ATC applications.

Related Projects/Activities:

- Mode S - The DLP will interface with the Mode S sensors for the reception and dissemination of Mode S data link transactions.
- Host - The DLP will be the interface between the Host and the Mode S network for the reception and dissemination of data link ATC transactions.
- WMSC/WMSC Replacement - The DLP will obtain alphanumeric weather products from the WMSC/WMSC Replacement for data link weather applications processing.
- ADAS - The ADAS will send minute-by-minute AWOS/ASOS messages to the DLP for storage and dissemination via data link.
- RMMS - The DLP will interface with the maintenance processor subsystem (MPS) for status reporting.
- RTR/VOR - The Tower Workstation will interface with the local RTR or VOR through existing ATIS recorders as required for the voice broadcast of ATIS messages.
- NICS - This project will require interfacility communications from NICS. A project providing that service is RML Replacement and Expansion which will provide the communications network for transmission of data.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IMPLEMENTATION
HOST DATA
LINK SOFTWARE
CONTRACT AWARD
IMPLEMENTATION

PROJECT 7: High-Altitude En Route Flight Advisory Service (EFAS) Frequencies

Purpose: This project will provide a clear communications channel at 18,000 feet and above for the collection and dissemination of pilot reports (PIREP) and en route weather information.

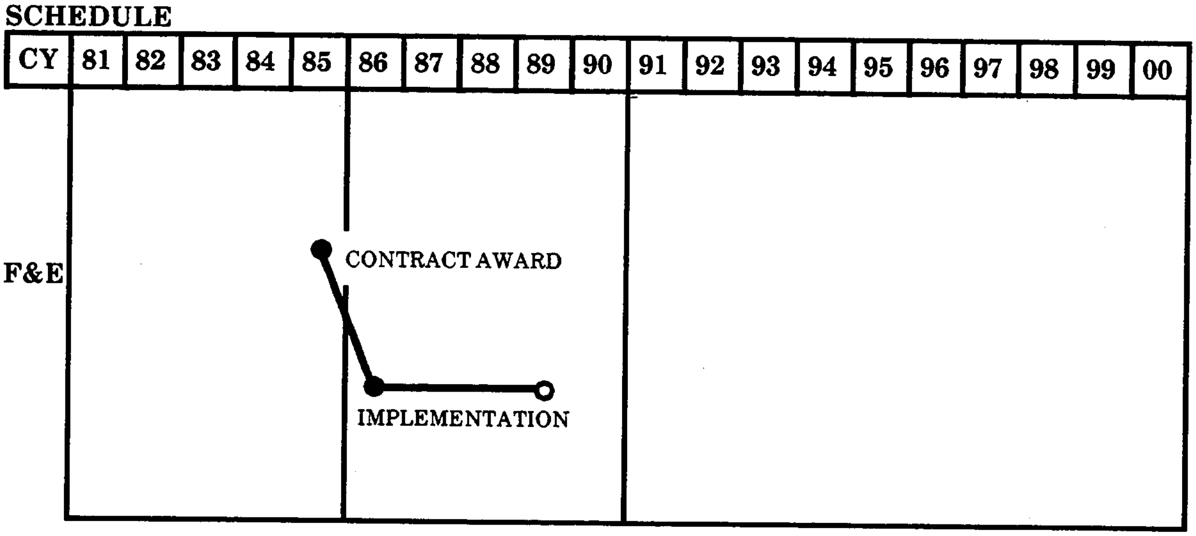
Approach: Based on the Nationwide Frequency Allocation Study, establish frequencies in addition to present en route flight advisory service (EFAS) at 122.0 MHz. Discrete frequencies have been assigned for each ARTCC area. The new frequencies will be protected from adjacent flight watch control station frequencies to reduce frequency overlap problems. Implementation for 20 FSS EFAS or AFSS EFAS facilities will use approximately 60 communications outlets selected in accordance with plans for air-ground communications facility consolidation.

Products: Forty-five of the 60 planned communications outlets controlled from FSS EFAS locations have been established.

Related Projects/Activities:

- Frequency and spectrum engineering will ensure that EFAS frequencies are free of interference.
- Site locations for EFAS equipment have been chosen in conjunction with communications facility consolidations.
- Hardware supporting this project have been procured in conjunction with Air/Ground Communications Modernization.
- FSAS – As FSS consolidation proceeds, service will be provided from 20 AFSSs.
- EFAS Expansion - Additional outlets are provided by the High-Altitude En Route Flight Advisory Service (EFAS) Expansion project in Chapter VII.

SCHEDULE



PROJECT 8: Hazardous In-Flight Weather Advisory Service (HIWAS)

Purpose: This project will provide continuous prerecorded broadcasts of weather advisories over selected VORs. Weather advisories include. significant meteorological information (SIGMET), convective SIGMETs, and significant pilot reports (PIREPs). HIWAS broadcasts will relieve flight service specialists from the labor-intensive task of broadcasting these weather advisories. HIWAS will also relieve air traffic controllers from broadcasting airmen's meteorological information (AIRMET), and improve the timeliness of dissemination.

Approach: A test was conducted in the Southern Region using 13 VOR locations in the Miami and Jacksonville ARTCC areas. Nationwide delivery was completed using sufficient VORs to provide communications coverage at and above 4,000 feet agl.

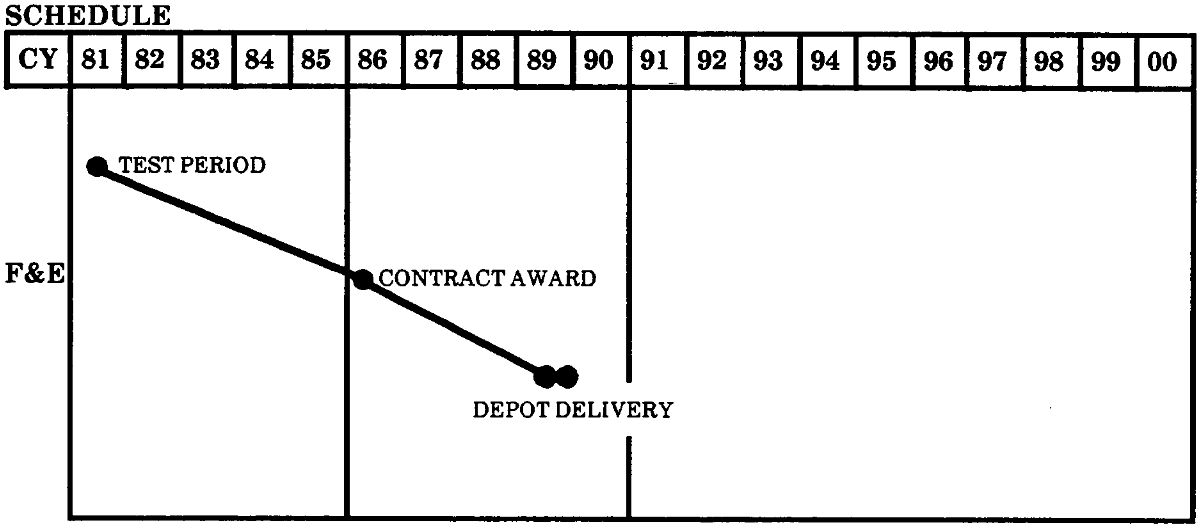
HIWAS will replace the 3-minute single-tape transcribed weather broadcast service now being provided by selected FSSs. The HIWAS VOR outlets will be selected to avoid competition for VOR voice features that are required for AWOS. The HIWAS recordings will be prepared manually by FSS specialists using solid-state recorders allowing up to 6-minute capacity. Due to equipment similarities, the HIWAS and ATIS recorders are being procured under the same contract.

Products: Recording equipment will be provided at a number of FSS locations to provide continuous broadcasts over selected VORs.

Related Projects/Activities: FSS consolidation will reduce the number of FSSs supplying manual HIWAS broadcasts. Frequency and spectrum engineering will protect frequency allocation. This project will require interfacility communications service from the NAS interfacility communications service (NICS).

PROJECT COMPLETE

SCHEDULE



PROJECT 9: Automated Weather Observing System (AWOS)

Purpose: AWOS will obtain aviation critical weather data (e.g., wind velocity, temperature, dew point, altimeter setting, cloud height, visibility, precipitation type, occurrence, and accumulation) through the use of automated sensors, process the data, and allow the dissemination of this information to pilots via computer synthesized voice.

Systems located within an ACF's area of responsibility will be connected to the AWOS Data Acquisition System (ADAS). The ADAS will primarily function as a message concentrator collecting weather messages from the AWOSs and National Weather Service Automated Surface Observing Systems (ASOSs) for internal distribution within the ACF and national distribution via WMSC Replacement to NWS. This will permit weather observation data to be made available to pilots on a timely basis for safety and efficiency. Additionally, timely observations are essential to improve forecasting.

Approach: A demonstration program for AWOS was successfully completed in 1984, and the FAA requirements for AWOS systems were specified. Immediately thereafter, a pilot program contract was awarded for a design of an AWOS for non-towered airports. In 1986 an Advisory Circular (AC 150/5220-16) was published for type certification and acquisition of AWOS devices by airport operators, fixed base operators, heliport operators, etc., for their needs. This document is the basis for systems to be funded and installed under the Airport Improvement Program (AIP).

The acquisition of production AWOS equipment is being accomplished through the procurement of commercial-off-the-shelf systems in accordance with the requirements of the Advisory Circular to meet immediate needs, and a national procurement by the National Weather Service for ASOS. The commercial systems will be primarily stand-alone units for airports currently without weather observers. These units will be installed between 1989 and early 1991 and will be maintained by the contractor. AWOS units may be replaced, as required, from NWS ASOS deliveries.

NWS will procure, install, and maintain ASOS equipment at selected airports. Implementation of these systems by NWS for nontowered airports will begin in early 1991 and be completed in 1992. Post 1992 requirements for 304 towered airports and FSS locations where the FAA currently takes surface observations will also be met by the NWS procurement.

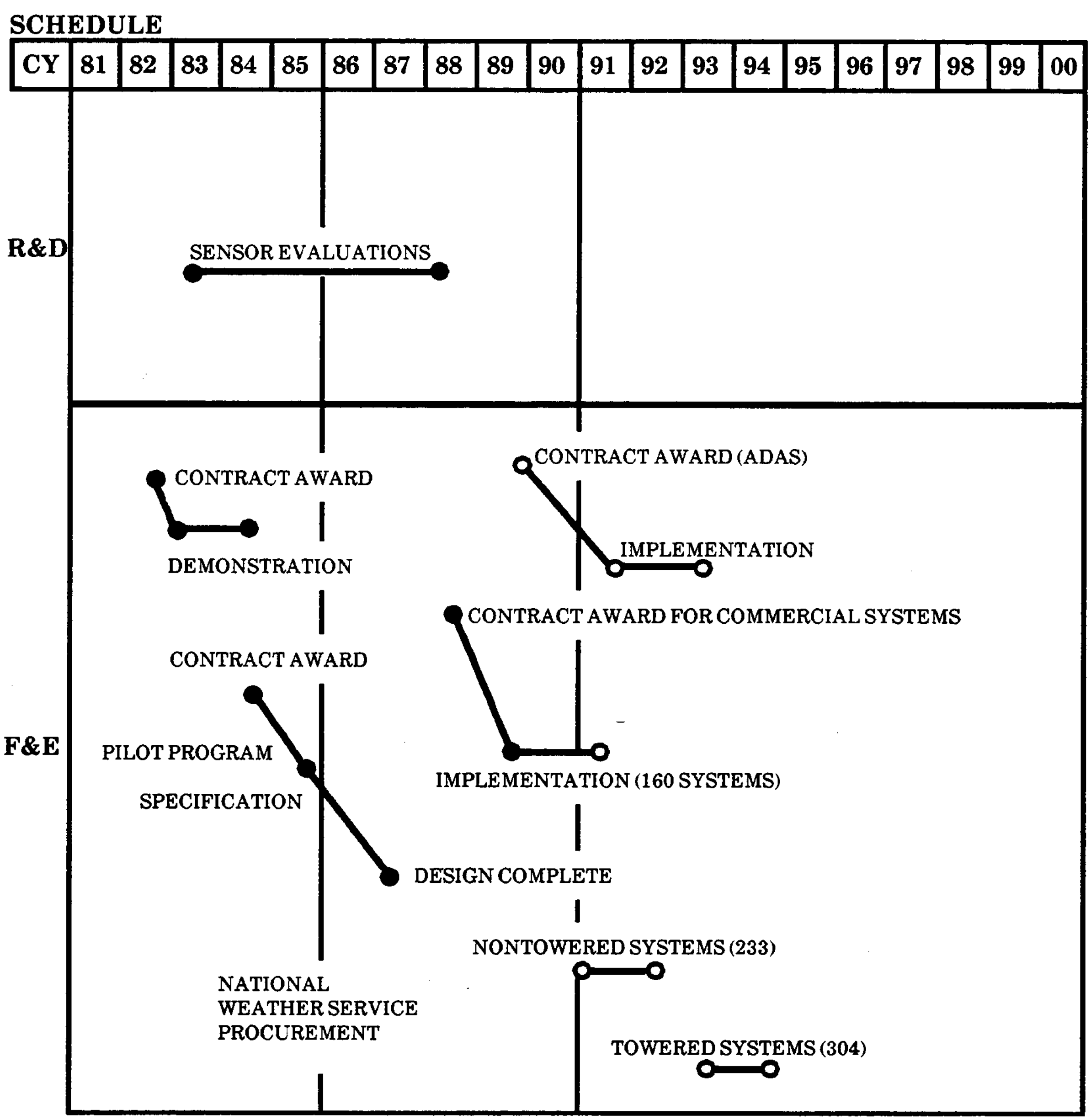
Products:

- 160 nontowered commercial systems (F&E funded, FAA contract).
- 233 nontowered airports (F&E funded, NWS contract). Options to include an additional 204 systems.
- 304 towered airports and/or closing FSSs (F&E funded - Post 1992, NWS contract).
- 400 nontowered airports (AIP funded). (Estimated).
- 25 ADASs - 23 to ACFs; 1 to FAA Academy; 1 to FAATC.

Related Projects/Activities:

- VOR/NDB network and consolidated communication facility implementation – AWOS data will be broadcast through VOR/ NDB or discrete VHF/UHF communications outlets depending on cost-effectiveness and spectrum engineering.
- ATIS – AWOS generated data will be furnished for controller's use and to update ATIS weather information if required.
- Rotorcraft program – AWOS will support the surface weather observation needs of FAA's rotorcraft programs as well as short-term forecasting.
- NAS spectrum engineering will provide interference-free frequencies for broadcasting AWOS information.

- NWS - ADAS will translate AWOS weather messages into the NWS standard aviation weather observation format.
- This project will require interfacility communications service from NICS. Projects providing that service include RML Replacement and Expansion, which will provide the transmission network for AWOS data, and data multiplexing which will consolidate the data for transmission.
- DLP - ADAS will provide minute-by-minute AWOS and ASOS data to the DLP to respond to pilot requests via Mode S data link.
- WMSC Replacement – The WMSC Replacement will receive AWOS and ASOS hourly and special weather messages through the ADAS.
- CWP - The RWP will receive the current (minute-by-minute) AWOS and ASOS weather messages from the ADAS for processing.



PROJECT 12: Low Level Wind Shear Alert System (LLWAS)

Purpose: This project will provide local controllers and pilots with information on hazardous wind conditions (on or near airports) that create unsafe conditions for aircraft landings or departures.

Approach: Wind shear detection equipment is being implemented through an ongoing program for the low level wind shear alert system (LLWAS). The basic 6-sensor system consists of a wind sensor located at center field, five sensors near the periphery of the airport, and a computer which processes sensor information and displays wind shear conditions to air traffic controllers for relay to pilots.

Since the basic 6-sensor LLWAS was designed primarily for the detection of frontal shears in the immediate vicinity of the airport, two avenues for improvement are planned.

Near-term modifications consist of improving the algorithms associated with the basic 6-sensor system to more effectively detect and identify microbursts, incorporating data recorders, and increasing the computer capacity. Long-term modifications include: expanding the existing systems by adding more sensors, correcting sensor height to reduce sheltering, developing improved algorithms, providing runway-oriented windshear information, and providing new data/alert displays. These improvements, in addition to increasing LLWASs capability to detect wind shear, will also reduce false alarms and enhance maintenance features. Extensive R&D efforts have contributed to LLWAS development. Two enhanced operational LLWAS test beds (consisting of one center field and eleven/twelve remote units) were installed in New Orleans/Denver to determine the benefits of increasing the number of sensors. Data from JAWS (Joint Airport Weather Studies), a combined effort involving the National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), National Science Foundation, and FAA permitted evaluation of different algorithms and optimization of the number of sensors.

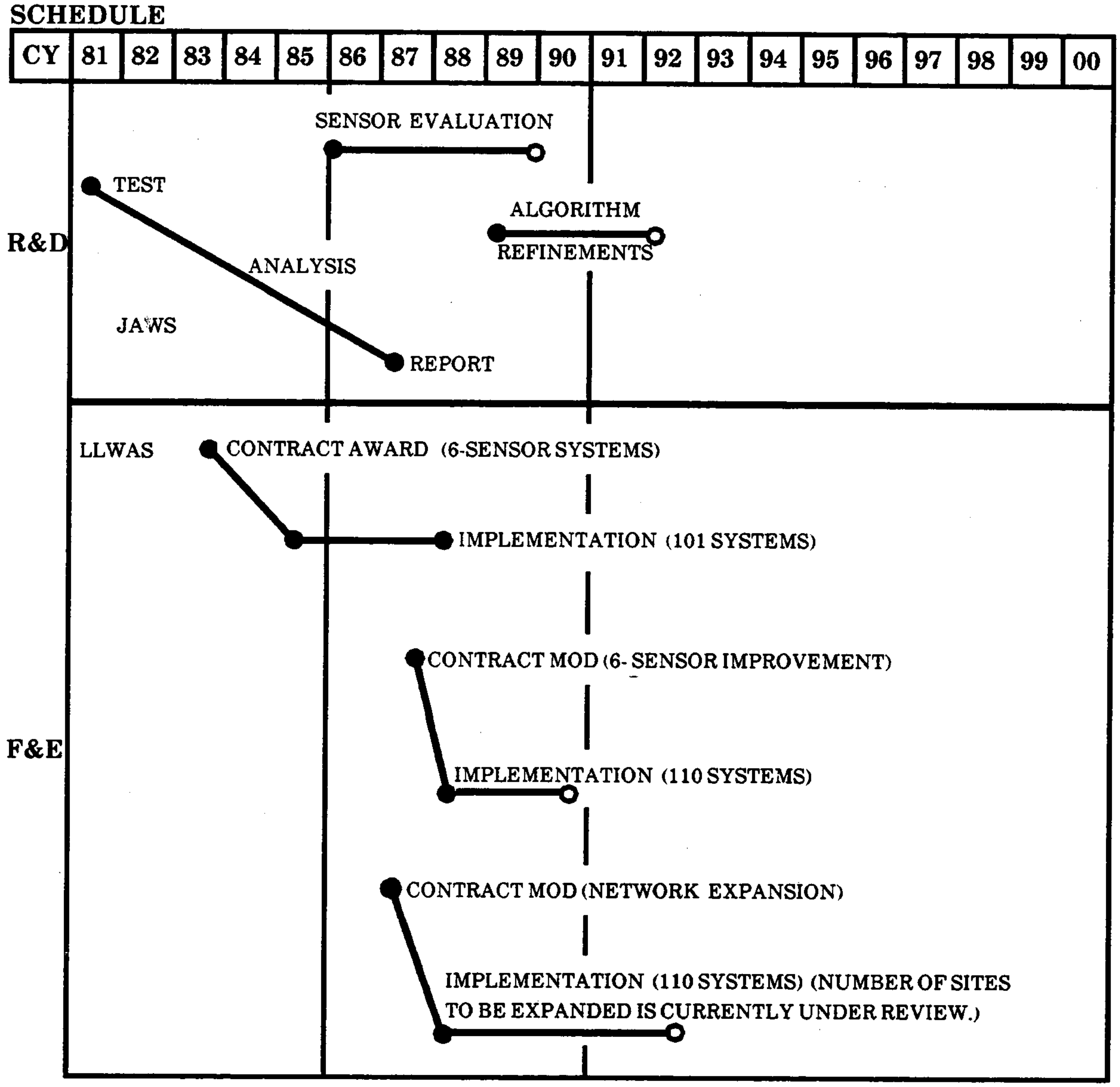
Products:

- JAWS research leading to algorithm development and evaluations.
- 110 near-term modifications (6-sensor improvement).
- Expansion of the 6-sensor LLWAS with improved algorithms, additional sensors, and new displays (network expansion). The number of sites to be expanded is currently under review.
- Develop interfaces to Terminal NEXRAD and TDWR.

Related Projects/Activities:

- AAS – In ATCTs, the tower control computer complex (TCCC) will receive and display LLWAS data to the ATCT controller.
- NAS frequency and spectrum engineering will ensure the LLWAS frequencies are free of interference.
- Terminal NEXRAD and TDWR are related projects when either system will be installed at the same airports as LLWAS.
- LLWAS will be interfaced to the MPS for remote maintenance monitoring.
- Provide full integrated logistical support capabilities to 110 LLWAS-equipped airports.

SCHEDULE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IMPLEMENTATION (101 SYSTEMS)
CONTRACT MOD (6-SENSOR IMPROVEMENT)
IMPLEMENTATION (110 SYSTEMS)
CONTRACT MOD (NETWORK EXPANSION)
IMPLEMENTATION (110 SYSTEMS) (NUMBER OF SITES
TO BE EXPANDED IS CURRENTLY UNDER REVIEW.)

PROJECT 13: Integrated Communications Switching System (ICSS)

Purpose: This project will provide voice communications switching systems for new, replaced, or modernized airport traffic control towers (ATCTs) and terminal radar approach controls (TRACONs) (previously provided with leased communication equipment), and for facilities which have obsolete equipment which can no longer be maintained. Also, it will provide systems for use at 61 automated FSSs (AFSSs).

Approach: An initial procurement (Phase I) and one reprocurement (Phase IA) are envisioned to implement ICSS. In the first phase, competitive proposals were solicited for off-the-shelf systems, dividing the requirement into three types with increasing technical capabilities:

- Type 1 for ATCTs and TRACONs having up to 15 operator positions. Basic intercom, interphone, and radio communications capabilities were specified as an integrated system.
- Type 2 for TRACONs having 16-80 operator positions. All Type 1 requirements plus rapid automatic reconfiguration of pushbutton terminations, alphanumeric displays of the button functions, and traffic data collection were specified.
- Type 3 for AFSSs. Type 2 requirements plus an automatic call distributor, call transfer, pilots automatic telephone weather answering service (PATWAS), fast file recorders, and a management information system display were specified. These systems will continue in use at all AFSS facilities.

First-phase contracts for all three types were awarded in May 1982. Type 1 systems are being obtained from one contractor. Type 2 systems are being obtained from another contractor. Both contractors are supplying Type 3 systems.

Under Phase I, systems are being leased with an option to buy. Systems are being purchased as funds are made available; the option is being exercised on a system-by-system basis.

Phase IA is the reprocurement phase. The contract for Phase IA was awarded in December 1988. Under this phase, the remainder of Type 3 ICSSs for AFSSs will be procured. Additional communications switches will be procured for facilities requiring switch replacement prior to the availability of TCS.

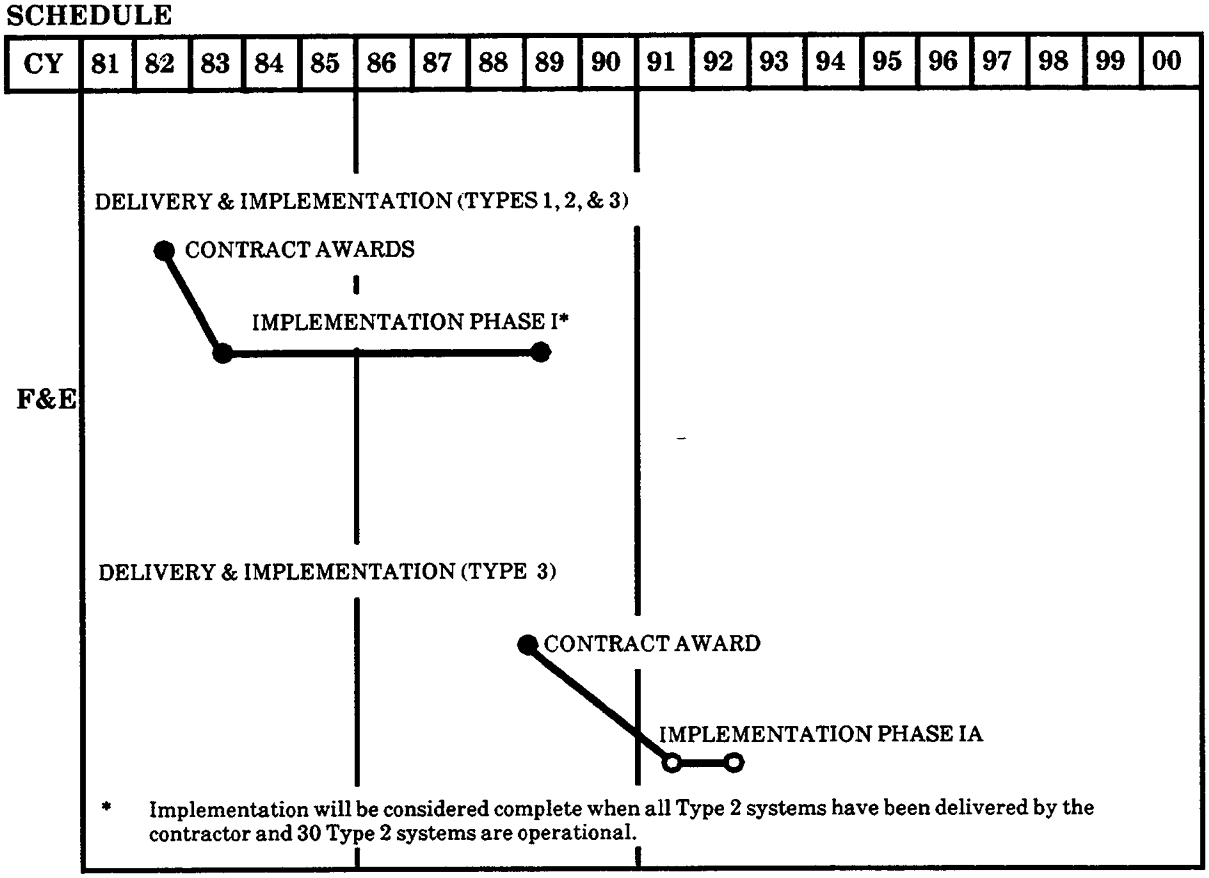
Products:

- Phase I:
  - 132 Type 1 systems for small ATCTs and TRACONs.
  - 31 Type 2 systems for larger TRACONs.
  - 45 Type 3 systems for AFSSs.
- Phase IA:
  - 16 Type 3 systems (plus 3 support systems for the Aeronautical Center).

Related Projects/Activities:

- ATCT and TRACON Replacement and Modernization – ICSS will be installed as voice communications switching system for new, replaced, or modernized ATCTs and TRACONs.
- FSAS – ICSS is the communications equipment of the AFSS facility that will enable the AFSS to establish voice communications with pilots and other operational personnel throughout the ATC system.
- TCS/VSCS - The ICSS will enable controllers and specialists to establish voice communications with operations personnel in ATCTs/TRACONs having a TCS and in ARTCCs and ACFs equipped with VSCS.
- NICS - Interfacility communication will be provided by NICS.

SCHEDULE



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DELIVERY & IMPLEMENTATION (TYPES 1, 2, & 3)
CONTRACT AWARDS
IMPLEMENTATION PHASE I*
DELIVERY & IMPLEMENTATION (TYPE 3)
CONTRACT AWARD
IMPLEMENTATION PHASE IA
* Implementation will be considered complete when all Type 2 systems have been delivered by the contractor and 30 Type 2 systems are operational.

CHAPTER IV

GROUND-TO-AIR SYSTEMS

e.g., ARTCCs, ATCTs, TRACONs, and FSSs. Approach and landing equipment is located at airports. The communication and surveillance equipment is located both at airports and remotely, as required, for en route operations.

Parts of the current electronic systems are old, vacuum-tube devices. Other parts of the systems are of more recent solid-state construction. The newest equipment is solid-state with remote monitoring capability.

COMMUNICATIONS

Ground-to-air communications facilities allow voice radio communications between air traffic control facilities and aircraft through the use of radio. Separate facilities are provided for communication between controllers and pilots in en route and terminal airspace. Other ground-to-air facilities provide communication between aircraft and flight service station specialists who advise pilots or are advised by pilots regarding their flight plans, weather, and other en route advisories.

The air route traffic control centers communicate with aircraft using remote center air/ground (RCAG) communications stations located to provide coverage for each en route air traffic control sector. The modernization of these facilities to replace vacuum-tube transmitter receiver equipment is complete. However, the present signaling and control equipment is obsolete, making it costly to maintain. The terminal area facilities use remote transmitter/receiver (RTR) stations for ground-to-air communications. The majority of them are still vacuum tube-type, and their signaling and control equipment is obsolete. The ground-to-air communication equipment at flight service stations is also obsolete since few of them are solid-state.

Military aircraft use the UHF tactical air navigation (TACAN) system for both azimuth and distance guidance. VOR, DME, and VOR/TACAN have been located to provide optimum guidance in those areas that are heavily traveled. Airways are comprised of line segments between these navigational facilities.

The nondirectional beacon (NDB) is a lower-cost, lower-capability alternative of the VOR station and is used where the air traffic demand for an air route is not great enough to justify the more expensive VOR. These beacons are used for en route guidance and fixes as well as being part of landing systems.

The implementation of the Department of Defense satellite-based global positioning system (GPS) will provide navigation coverage unavailable today and allow increased direct navigation on fuel-efficient paths. Until the GPS is in widespread use throughout the NAS, the LORAN C system can function as an interim, supplementary navigation system for those areas not fully covered by the airways.

The Airways System is used to maintain a safe and controlled airspace using existing technology. Aircraft equipped for area navigation can fly direct efficient paths, but this application is limited due to the present air traffic control system's problems with handling aircraft outside the air route structure.

Some of the navigational aid equipment is obsolete, costly to maintain, and is being replaced with modern solid-state devices.

APPROACH AND LANDING AIDS

The present airport electronic approach and landing system is the instrument landing system (ILS). Precision approach ILS provides both azimuth and elevation guidance to a runway from a ground facility. Marker beacons, lighting systems, distance measuring equipment, and compass locators are associated with ILS to enable equipped aircraft to fly radar relies only on signals reflected from aircraft or from weather. The beacon system receives reply signals transmitted from airborne electronic equipment called transponders. On aircraft equipped with altitude encoders, the transponder automatically transmits the aircraft's altitude. The beacon system is presently the main source of surveillance information used for air traffic control. Search radar supplements beacon and gives weather information.

There are, additionally, two types of search radars. The en route air traffic control system relies principally on air route surveillance radar (ARSR)/long range radar (LRR), while the terminal air traffic control system uses shorter range airport surveillance radar (ASR). Both radars are used extensively for flight monitoring. Some existing radars are tube-type and obsolete, while others are solid-state. Because search radar was designed for aircraft surveillance, it is presently capable of giving only limited information on weather and precipitation. Another type of radar, airport surface detection equipment (ASDE), is used by tower controllers to detect aircraft and vehicles on runways and taxiways during low-visibility conditions.

The direction finder (DF) is used to locate lost aircraft and for other emergencies. The aircraft's bearing is determined on the ground by using radio transmissions from the aircraft. The guidance information is then transmitted to the aircraft on a voice channel. The majority of the present DF systems are tube type and are located at flight service stations.

THE NEW APPROACH

The major improvements of this chapter upgrade ground-to-air systems to solid-state; provide for remote maintenance monitoring; and match the location of navigation, surveillance, approach and landing systems, and communications facilities with altitudes the closer an aircraft is to a facility. Radar surveillance with Mode S or an ATC radar beacon system (ATCRBS) will be provided down to the ground at qualifying airports. Ultimately, as traffic growth requires, surveillance radar and Mode S coverage will be provided down to 6,000 feet altitude above mean sea level or the minimum en route instrument flight rule (IFR) altitude, whichever is higher. Weather radar coverage will be provided above 10,000 feet and down to the surface at selected airports. En route navigation and communication coverages will be available 2,000 feet above the terrain except where there is little air traffic. Direction finder coverage will be expanded as required, emphasizing those areas below radar coverage.

The ground-to-air communications system will be improved and modernized by replacing old, obsolete tube-type equipment with new solid-state equipment. Further improvement to operating cost will result from consolidation of as many facilities as practical. This will be done without loss of required service coverage. Communications and navigation networking studies will aid in identifying candidates for consolidation or relocation.

The navigation system will further be improved by replacement of maintenance-intensive equipment with solid-state systems and establishment of additional systems to provide coverage where it is required and not available today. In addition to VOR and DME equipment, which is the primary navigational system, the global positioning system will gain popularity as a navigational system. LORAN C, with over 40,000 users already equipped, will be expanded to provide midcontinent coverage. LORAN C monitors will be installed to support nonprecision approaches by providing accuracy and availability information.

including new types such as precision approach path indicators (PAPI), will be installed to enhance safety during visual approaches to airports. Approach lighting will provide lighting necessary for various categories of terminal operations.

Surveillance systems will undergo the most radical changes. The addition of Mode S will provide more accurate aircraft positioning information, allow for discrete aircraft identification, and provide the framework for data link services. New terminal radars will replace vacuum-tube systems that are difficult to maintain, and an expanded number of locations will have radar service. New airport surface detection equipment will replace the present systems; and new locations will be established, providing the ground surveillance capability required at our busiest airports. New ASDE will provide controllers with more accurate and reliable information than those radars presently installed and will greatly increase the safety of ground movement of aircraft.

Long range radar, including those radars currently installed at joint-use locations, will be solid-state. The joint use of military radars to supplement existing coverage will be expanded.

New weather radar will provide more reliable and accurate data to aid in forecasts and detection of real-time weather phenomenon.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Many ground-to-air systems improvements required through the initial period have been completed. The main focus has been the replacement of obsolete vacuum-tube equipment. The newer solid-state equipment has remote monitoring and control capability for more cost-effective systems maintenance.

operation. In 1984, a contract was awarded for upgrading nondirectional beacons.

Many ILS vacuum-tube components have been replaced. Where demand increases dictate, systems have been upgraded to higher categories. A contract was awarded for remote maintenance monitoring retrofit of the ILS. The first contract for the new microwave landing system has been awarded. Operational procedures for its use are being finalized. International standards for the precision distance measuring equipment (DME/P) portion of the MLS have been incorporated into ICAO Annex 10.

Approach lighting systems have been installed as required for runway upgrades and in conjunction with electronic landing systems. A contract has been awarded for improved remote radio control of lighting systems from the tower cab and aircraft. A contract was awarded in 1985 for the new precision approach path indicators. The approach lighting system improvement program, providing for frangible supports and some upgraded components, was started in 1984 and is proceeding on a regional priority schedule.

Establishment of 125 direction finders (DF) was completed and the procurement process for additional establishments and replacements has started. The contracts for replacement of ASR 4/5/6 tube-type terminal radars and vacuum-tube components of long-range radars have been awarded. Mode S equipment acquisition for 137 locations is also underway. As a temporary measure, an interim ASDE has been provided for Anchorage, Alaska. The contract for replacement of all tube-type ASDE and establishment of 17 qualifying new locations was awarded in 1985.

tinue. The establishment of required NDBs will be completed. Implementation of LORAN C monitors to provide non-precision approach correction data will be underway.

ILS establishments to satisfy critical requirements and ILS tube-type component replacements have been completed.

The initially procured runway visual range (RVR) systems will be installed, the follow-on procurement awarded, and implementation of the second buy will be about to begin.

Implementation of visual navaids, including PAPI systems, and the approach light improvement program will also continue.

Direction finder establishment will continue, along with the co-location of facilities, to reduce overhead operational costs.

The implementation of the first 137 Mode S systems will be underway and initial weather services will soon be available over data link. Long range radar tube-type component upgrade will be nearly completed. Terminal radar replacement and establishment, ASR 7/8 relocation and ASDE implementation will be well underway. The ARSR 4 contract has been awarded. Contracts for weather radars (NEXRAD and TDWR) have been awarded and implementation of the first NEXRAD will be underway.

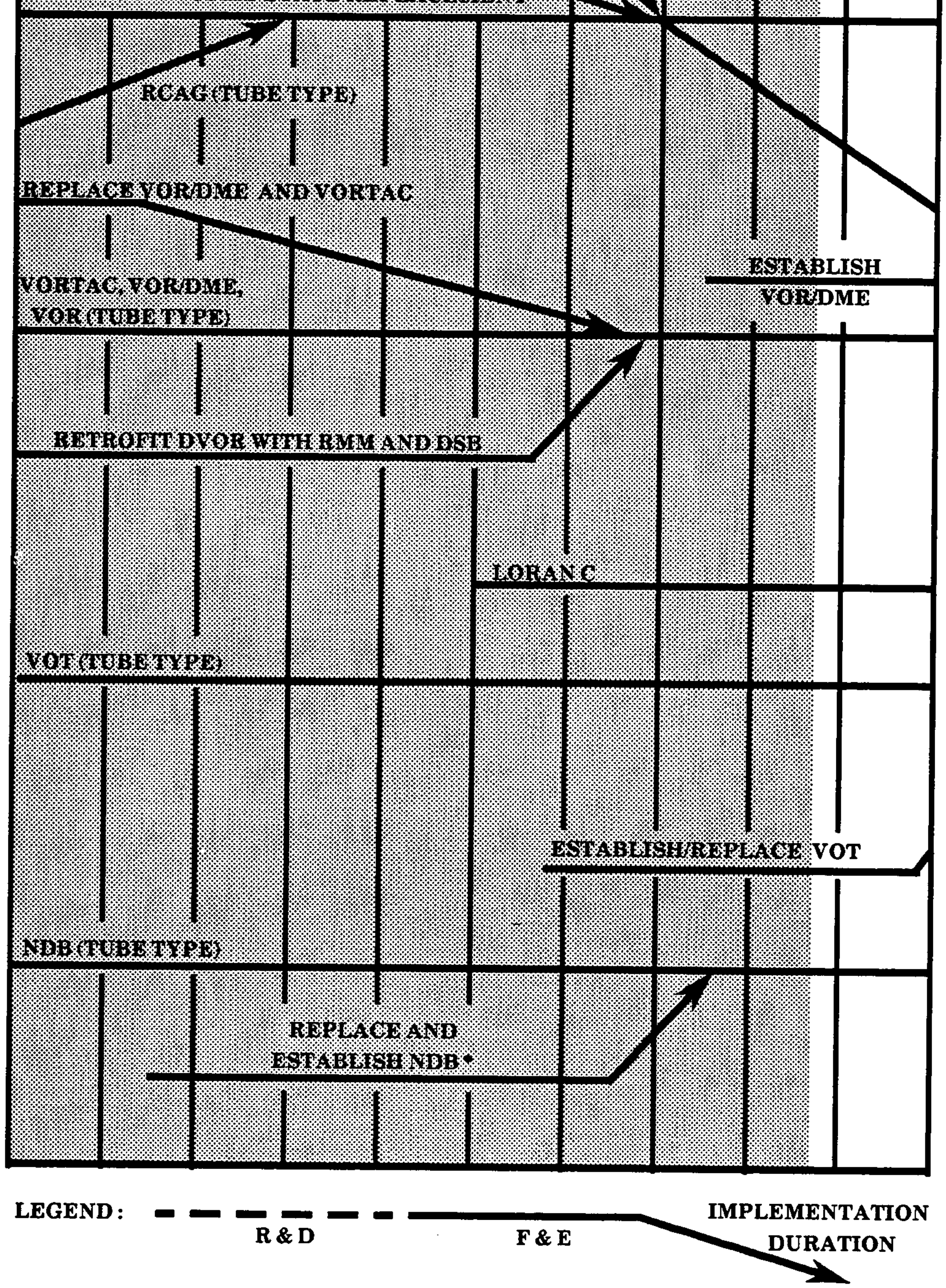
Implementation of RVR systems will be complete. Implementation of visual approach and landing aids will continue. The approach lighting system improvement program will be completed. Establishment and co-location of DFs with other equipment to share buildings and utilities will be completed.

Implementation of NEXRAD and TDWR weather radars will be complete. ASR 7/8 radars will be relocated. Thirty ASDE 3s, 40 three-dimensional long range radars and 197 Mode S units will be implemented. Data link coverage will extend down to 6,000 feet above mean sea level or minimum en route instrument flight rule altitude, whichever is higher, providing weather and automated air traffic services to lower flying aircraft. Aviation weather will be available to pilots on request through data link. Mode S data link will also provide the medium for transmission of ATC clearance to pilots in the cockpit.

In designated airspace, aircraft will be equipped with Mode S to derive the benefits of automated services. Weather radar information will be improved as the FAA weather network (including NEXRAD) becomes operational.

FAA en route search radar may be decommissioned if all aircraft are transponder equipped while operating above 6,000 feet and required FAA weather radar information is obtained from NEXRAD weather radar facilities.

The following diagrams and maps describe the evolution of the system.


RCAG (TUBE TYPE)
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LEGEND:
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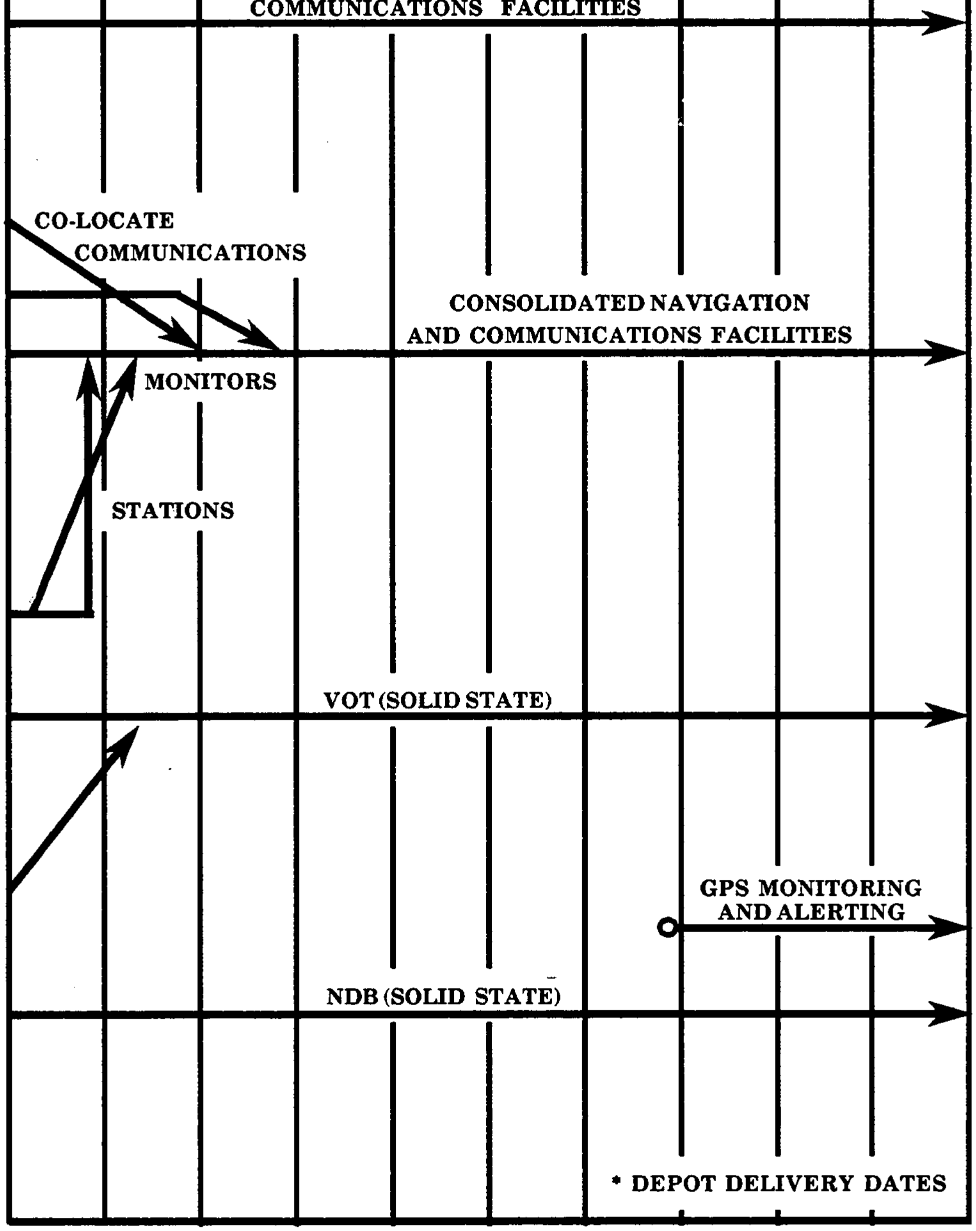
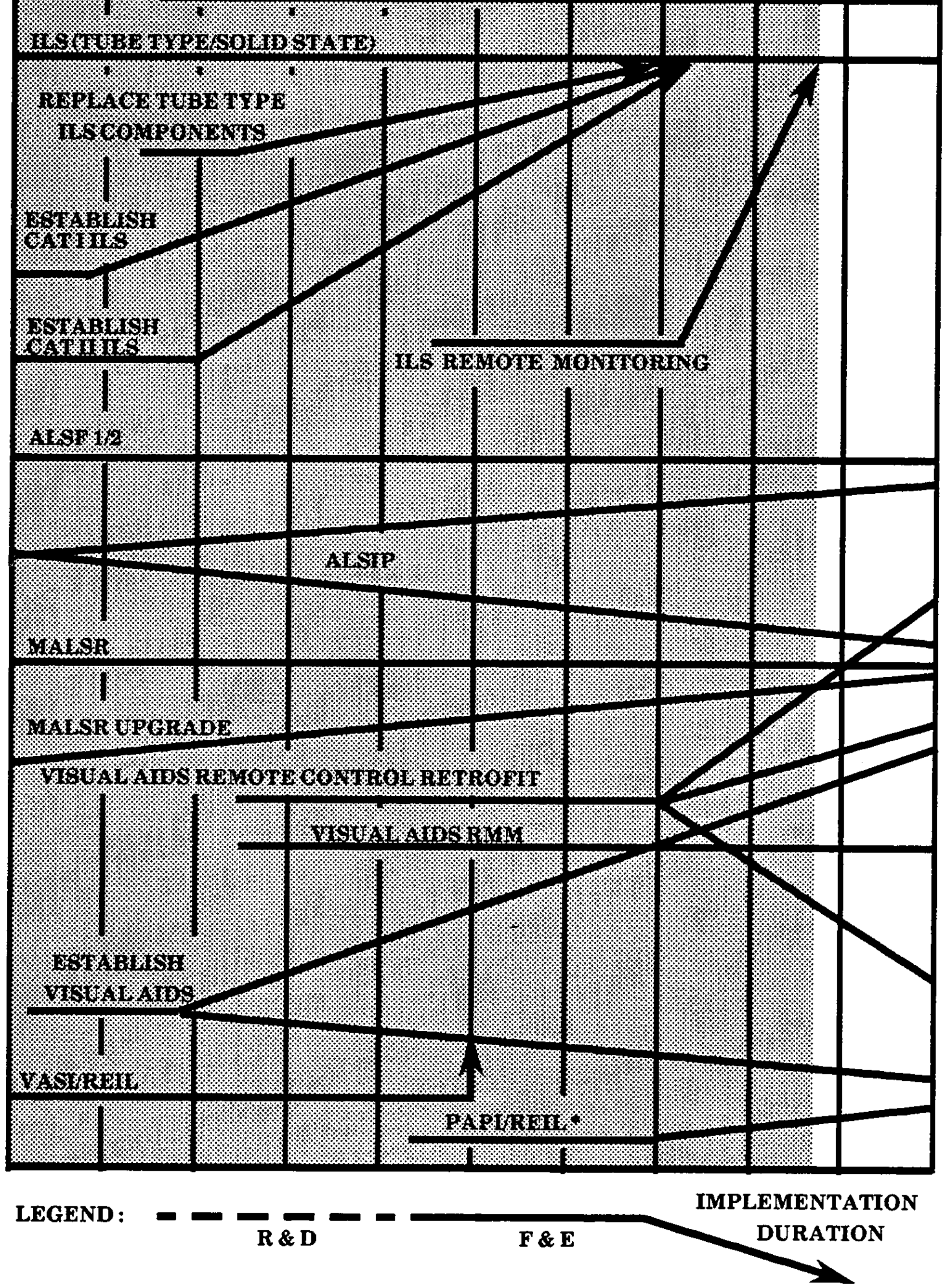
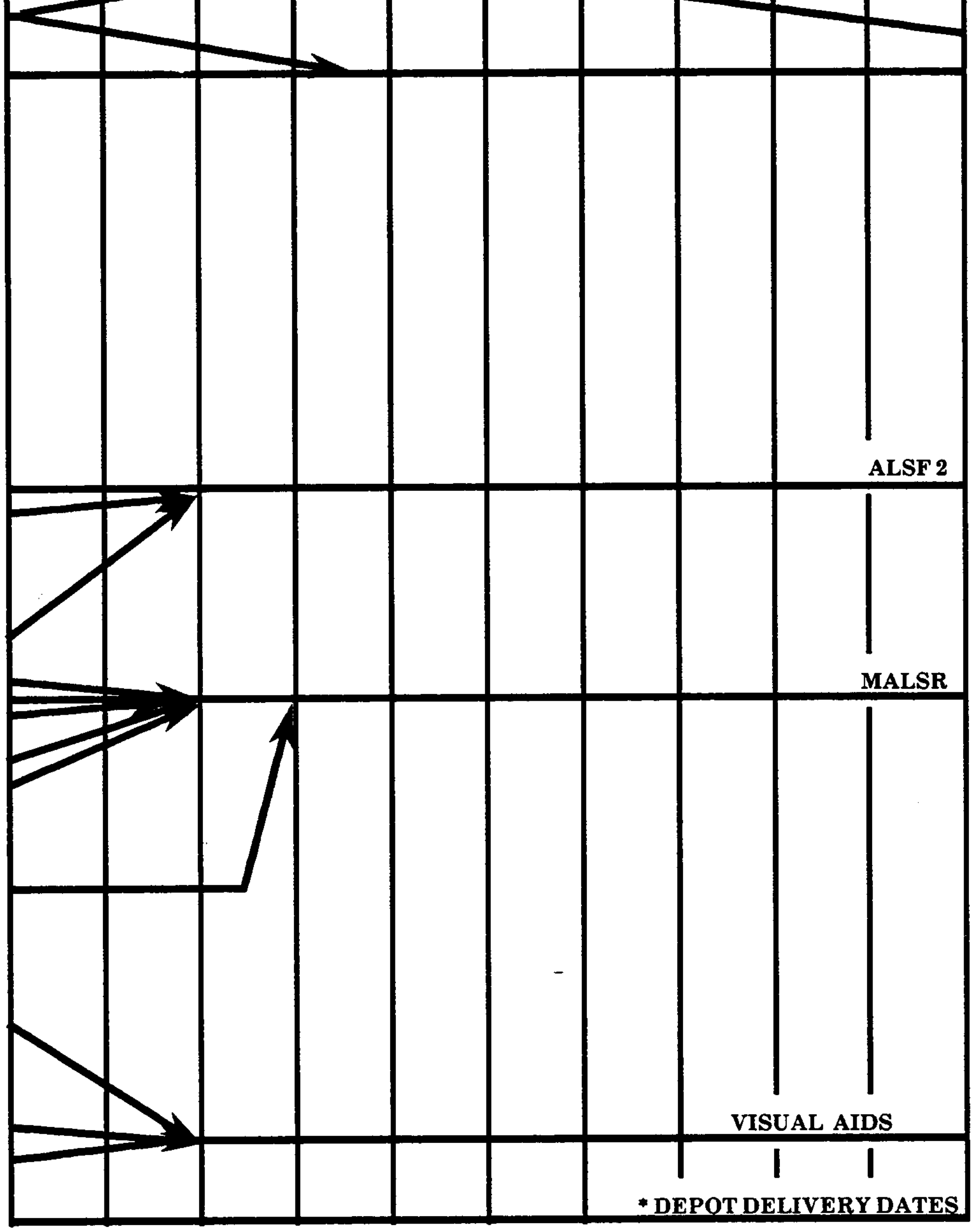
F & E
IMPLEMENTATION
DURATION



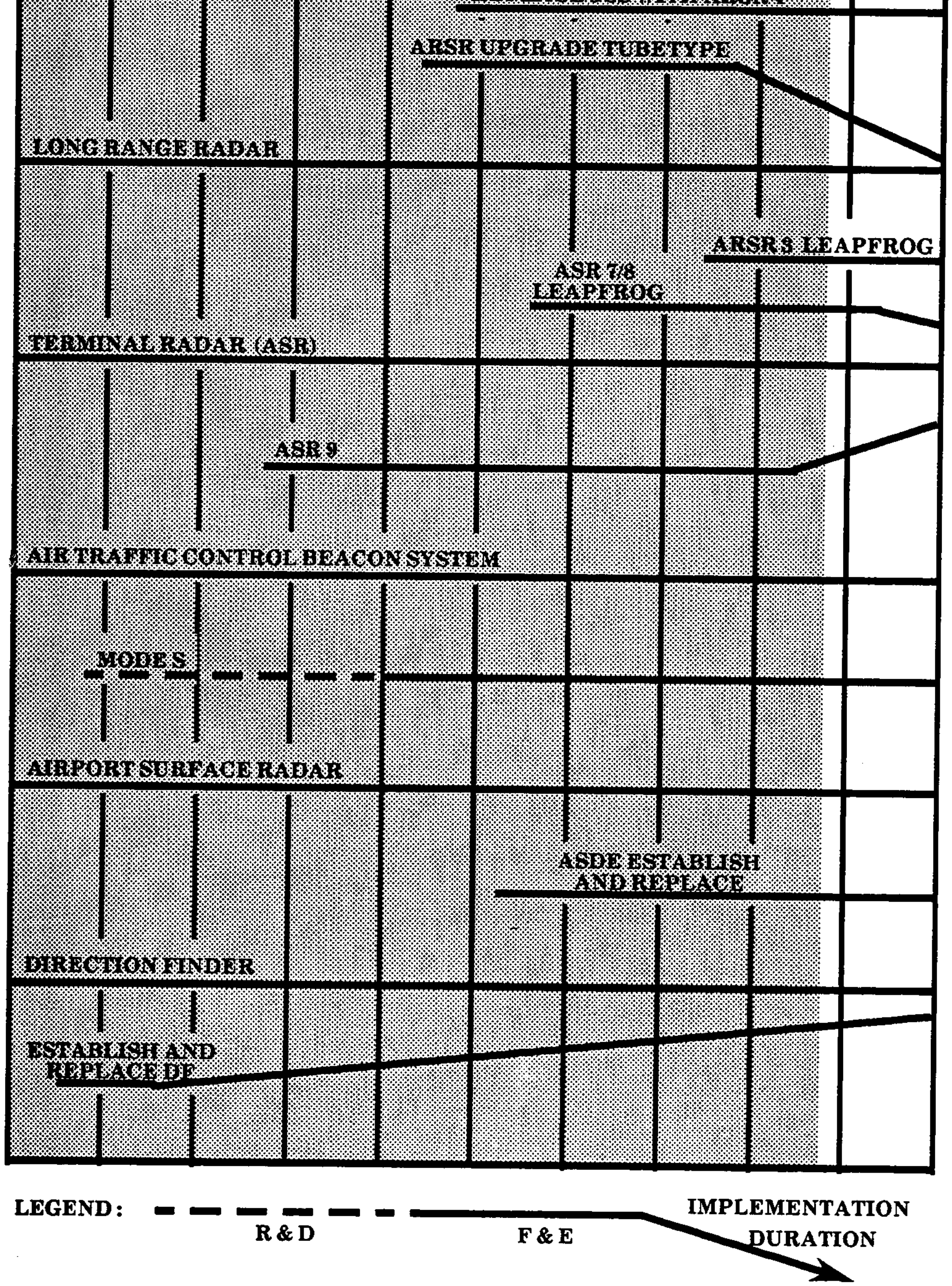
NAVIGATION AND COMMUNICATIONS SYSTEM EVOLUTION

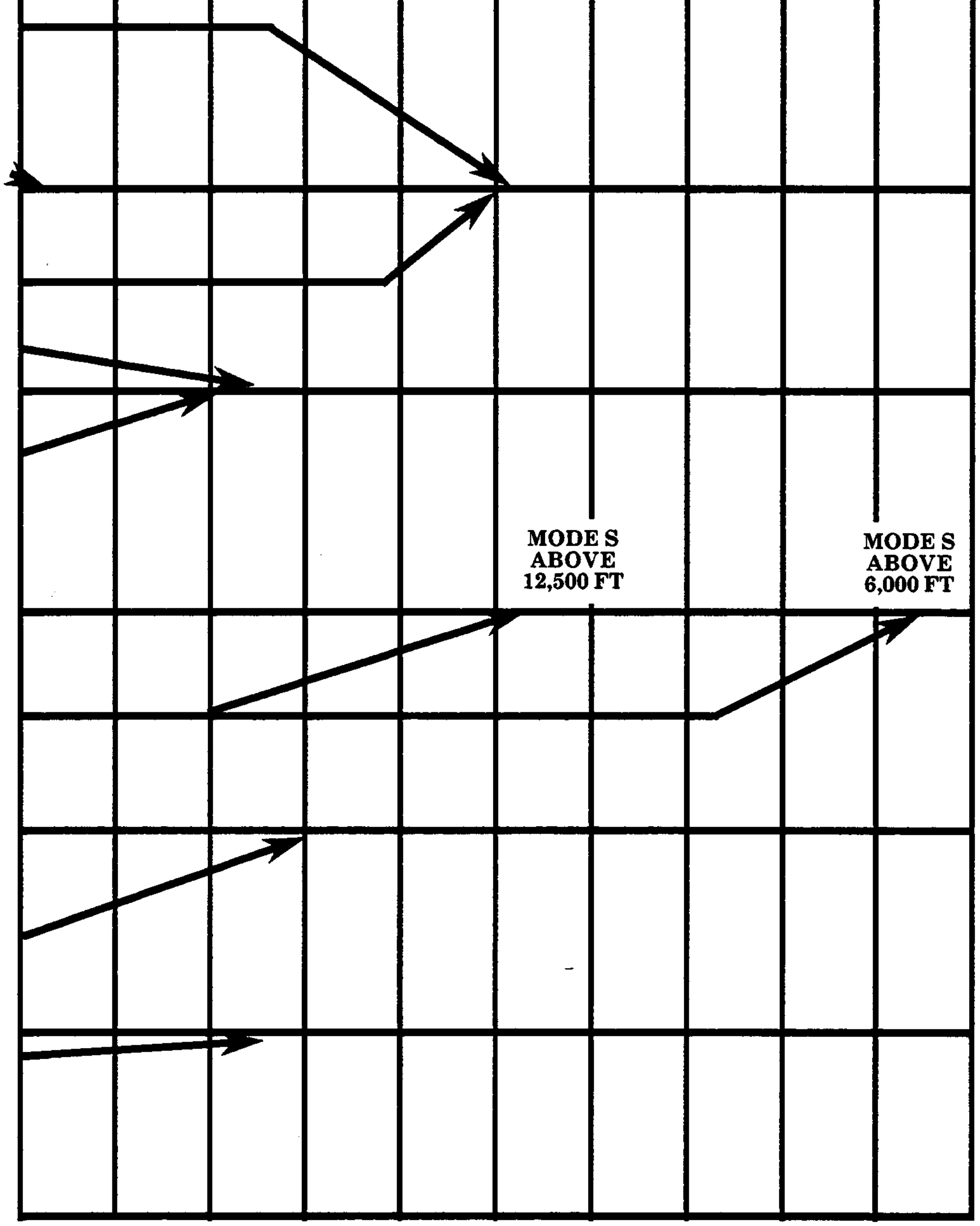


ILS (TUBE TYPE/SOLID STATE)
REPLACE TUBE TYPE ILS COMPONENTS
ESTABLISH CAT I ILS
ESTABLISH CAT II ILS
ILS REMOTE MONITORING
ALSF 1/2
ALSIP
MALSR
MALSR UPGRADE
VISUAL AIDS REMOTE CONTROL RETROFIT
VISUAL AIDS RMM
ESTABLISH VISUAL AIDS
VASI/REIL
PAPI/REIL *
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION

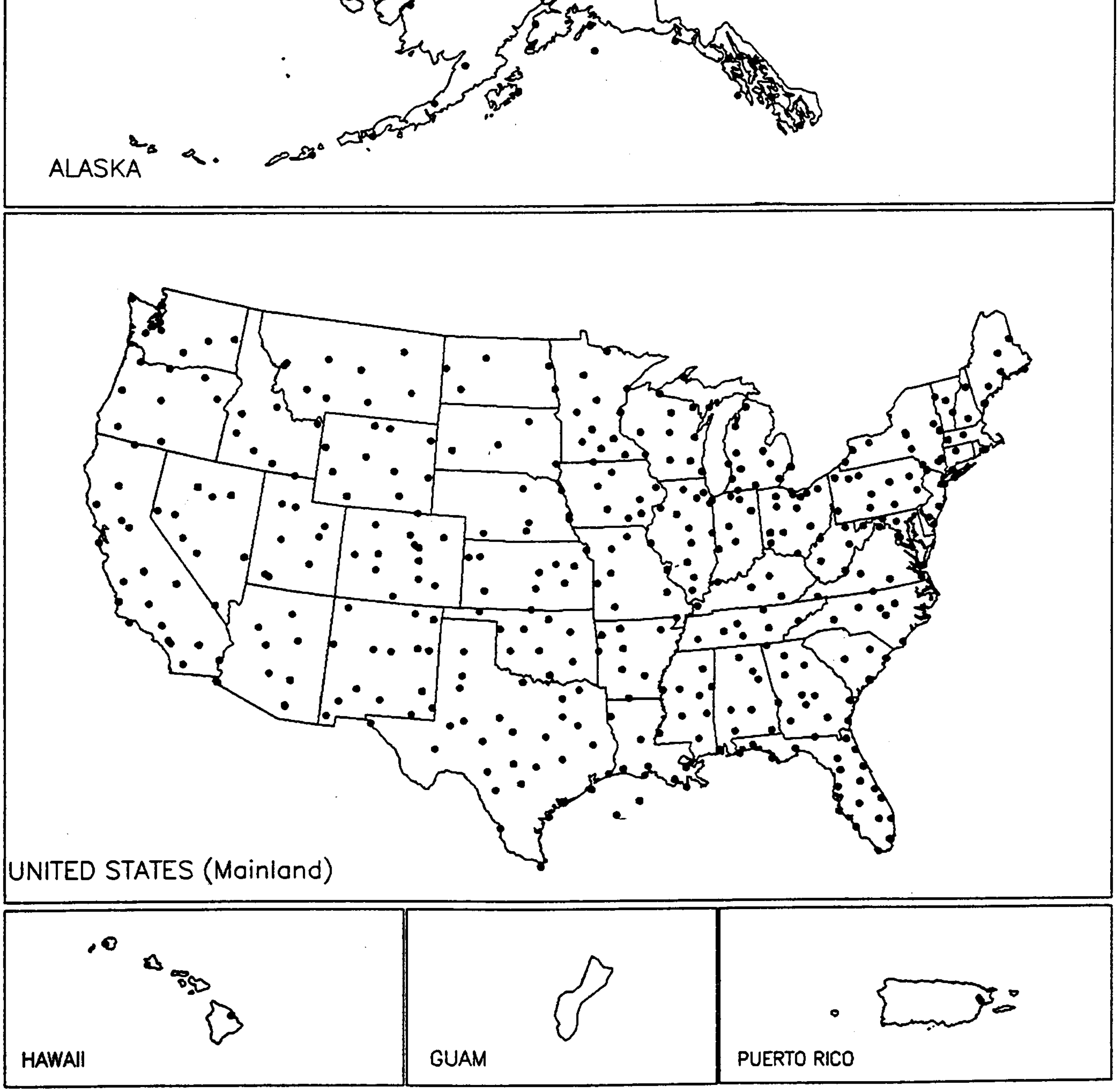


LANDING SYSTEMS EVOLUTION

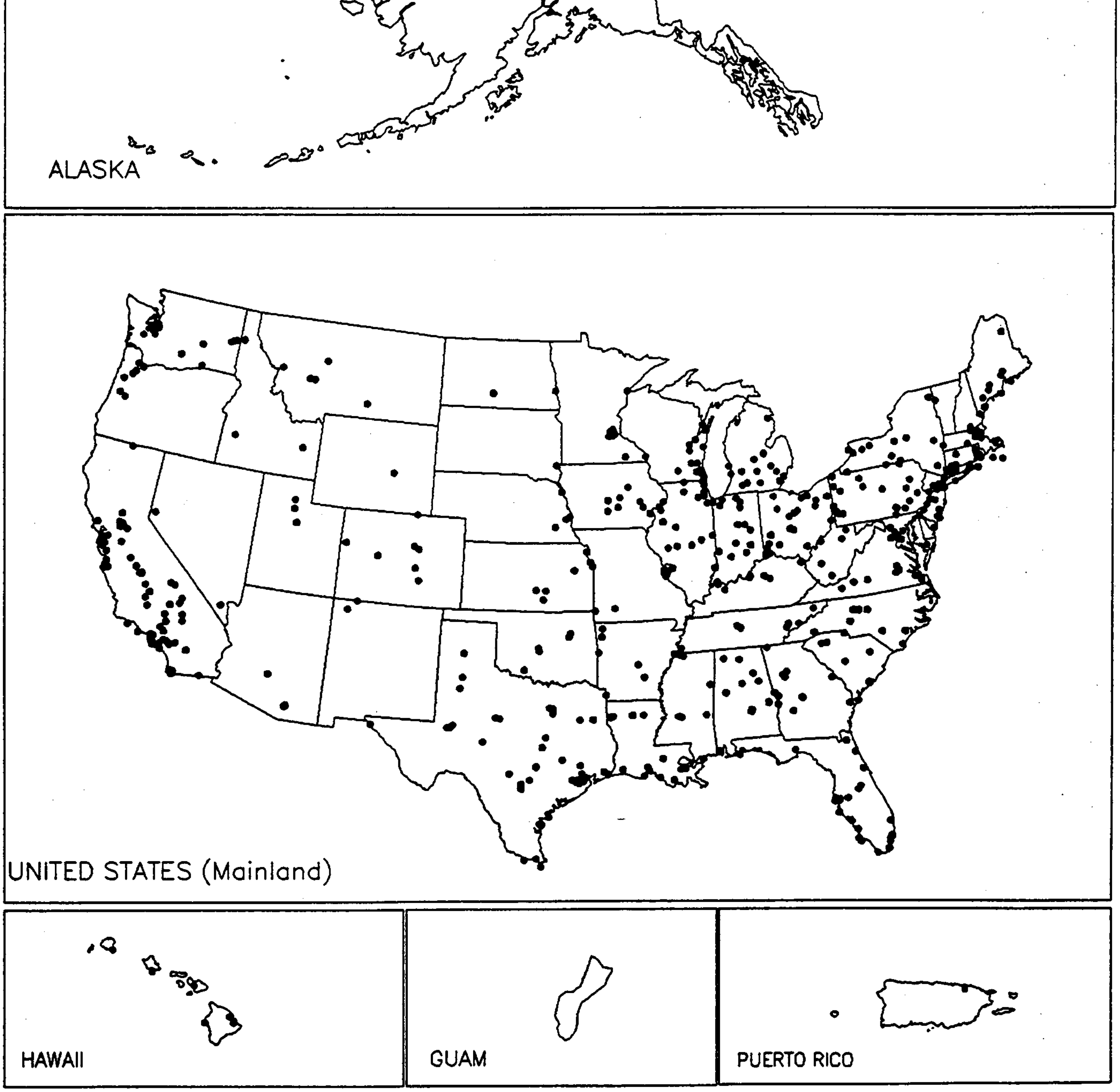

ARSR UPGRADE TUBETYPE
LONG RANGE RADAR
ARSR 3 LEAPFROG
ASR 7/8
LEAPFROG
TERMINAL RADAR (ASR)
ASR 9
AIR TRAFFIC CONTROL BEACON SYSTEM
MODE S
AIRPORT SURFACE RADAR
ASDE ESTABLISH
AND REPLACE
DIRECTION FINDER
ESTABLISH AND
REPLACE DF
LEGEND:
R & D
F & E
IMPLEMENTATION
DURATION



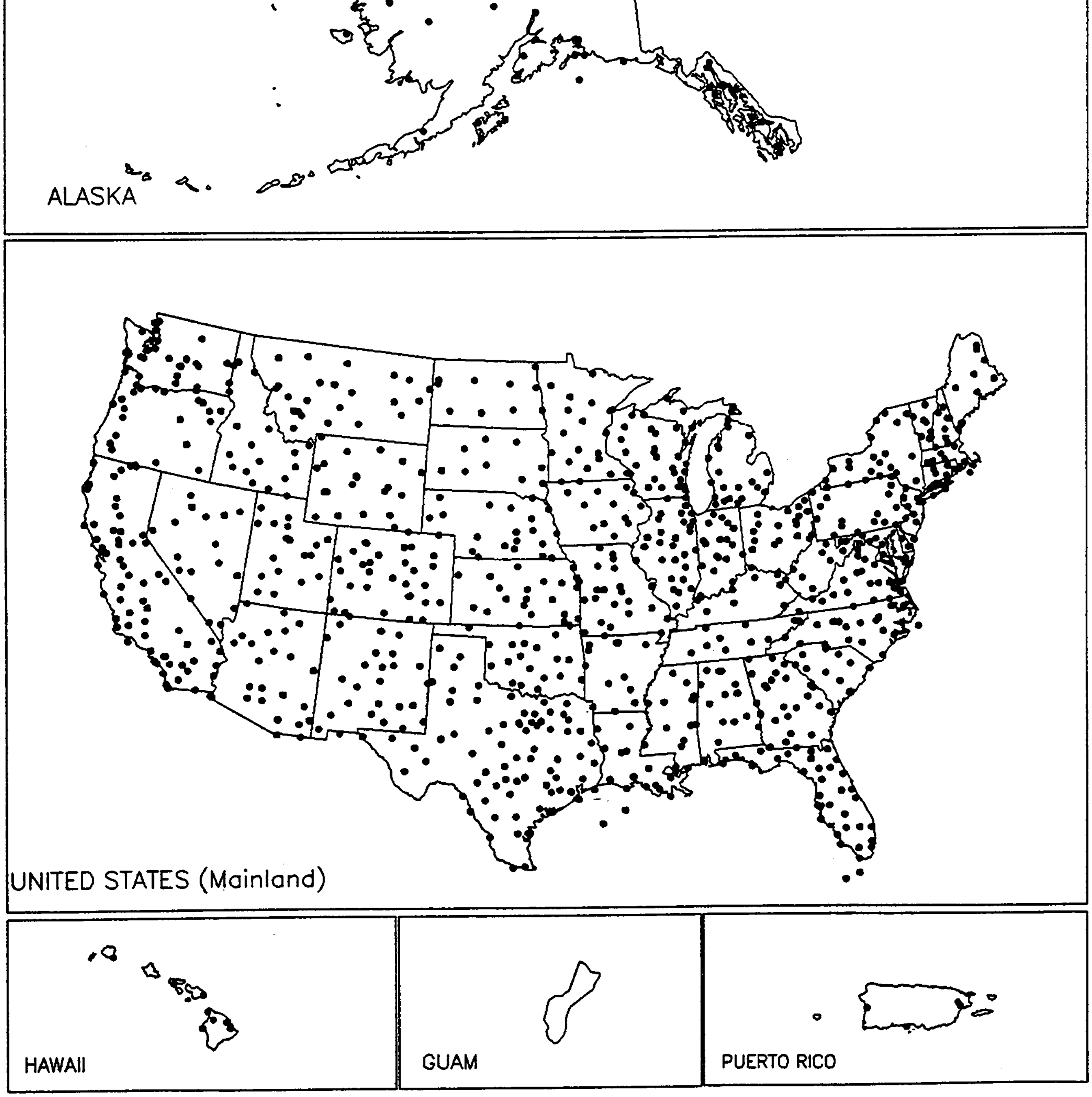
SURVEILLANCE SYSTEMS EVOLUTION



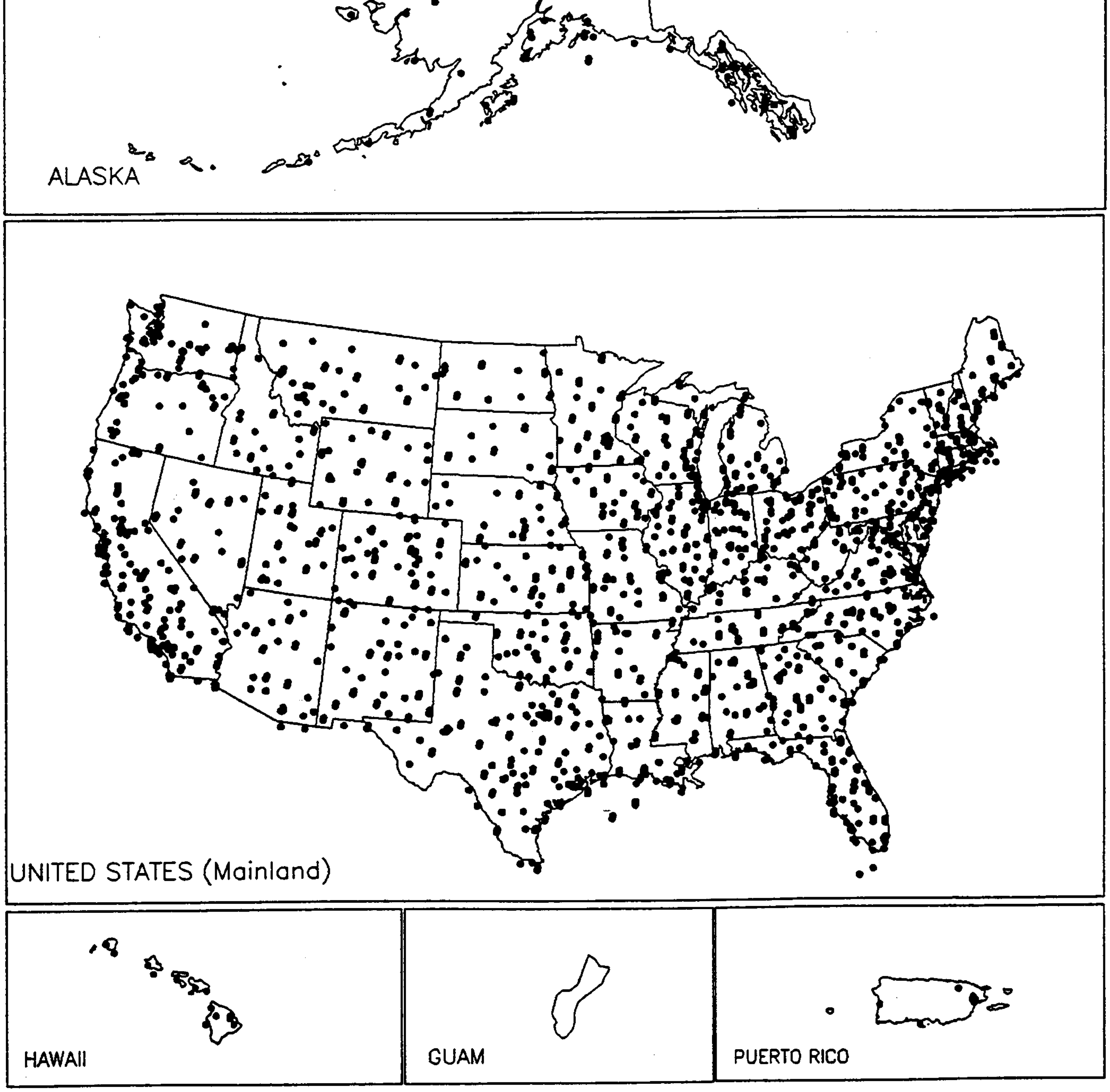
CURRENT SYSTEM
EN ROUTE COMMUNICATIONS



CURRENT SYSTEM
TERMINAL COMMUNICATIONS



CURRENT SYSTEM
FLIGHT SERVICE COMMUNICATIONS

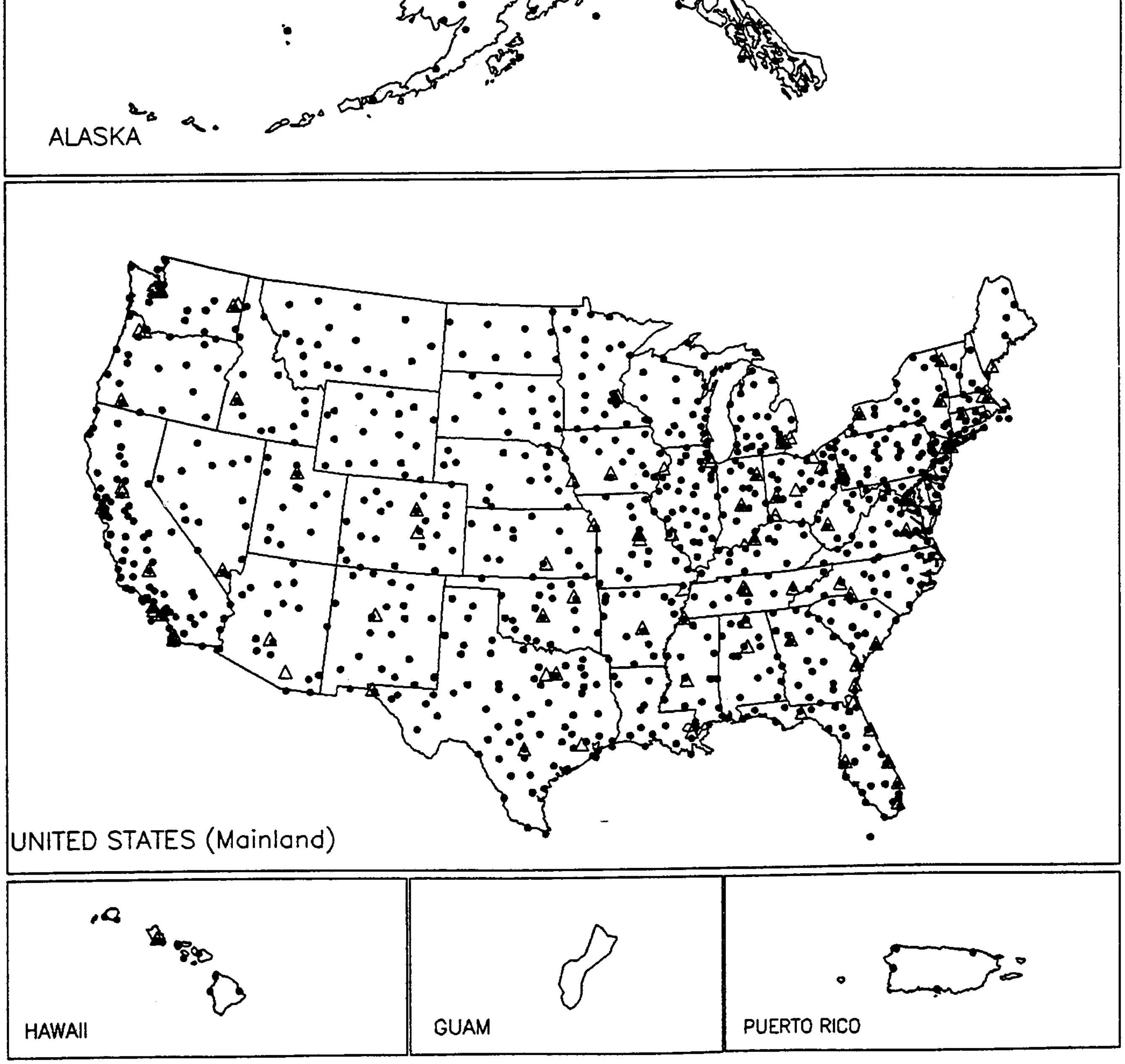


2000 SYSTEM
AIR/GROUND COMMUNICATIONS

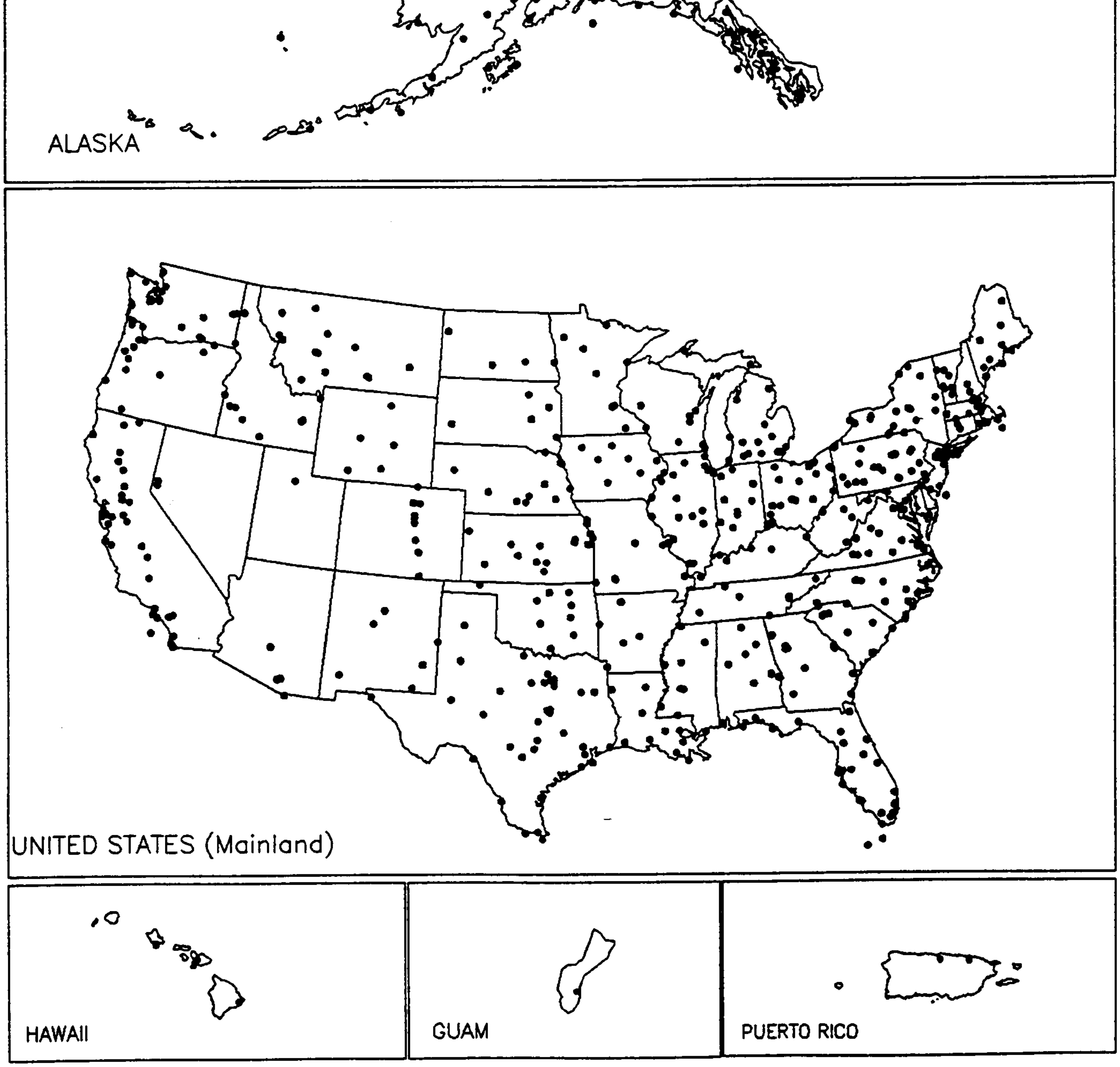
THIS MAP ALSO DEPICTS THE VHF OMNI DIRECTIONAL RANGE TEST (VOT) EQUIPMENT FOR THE YEAR 2000. THESE SYSTEMS PROVIDE A SIGNAL FOR CALIBRATION AND VERIFICATION OF AIRCRAFT VOR EQUIPMENT.

● VOR EQUIPMENT

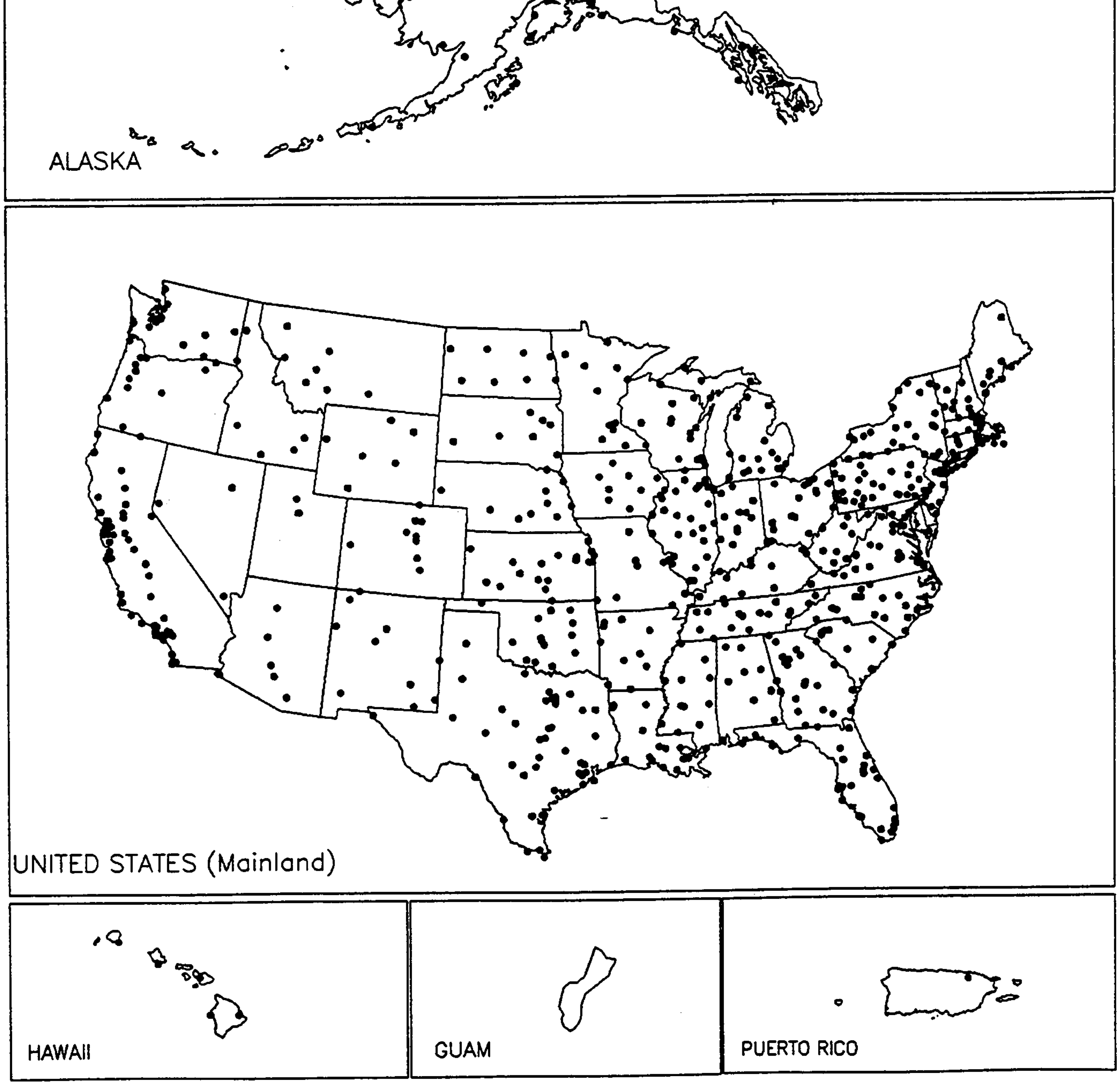
△ VOT EQUIPMENT



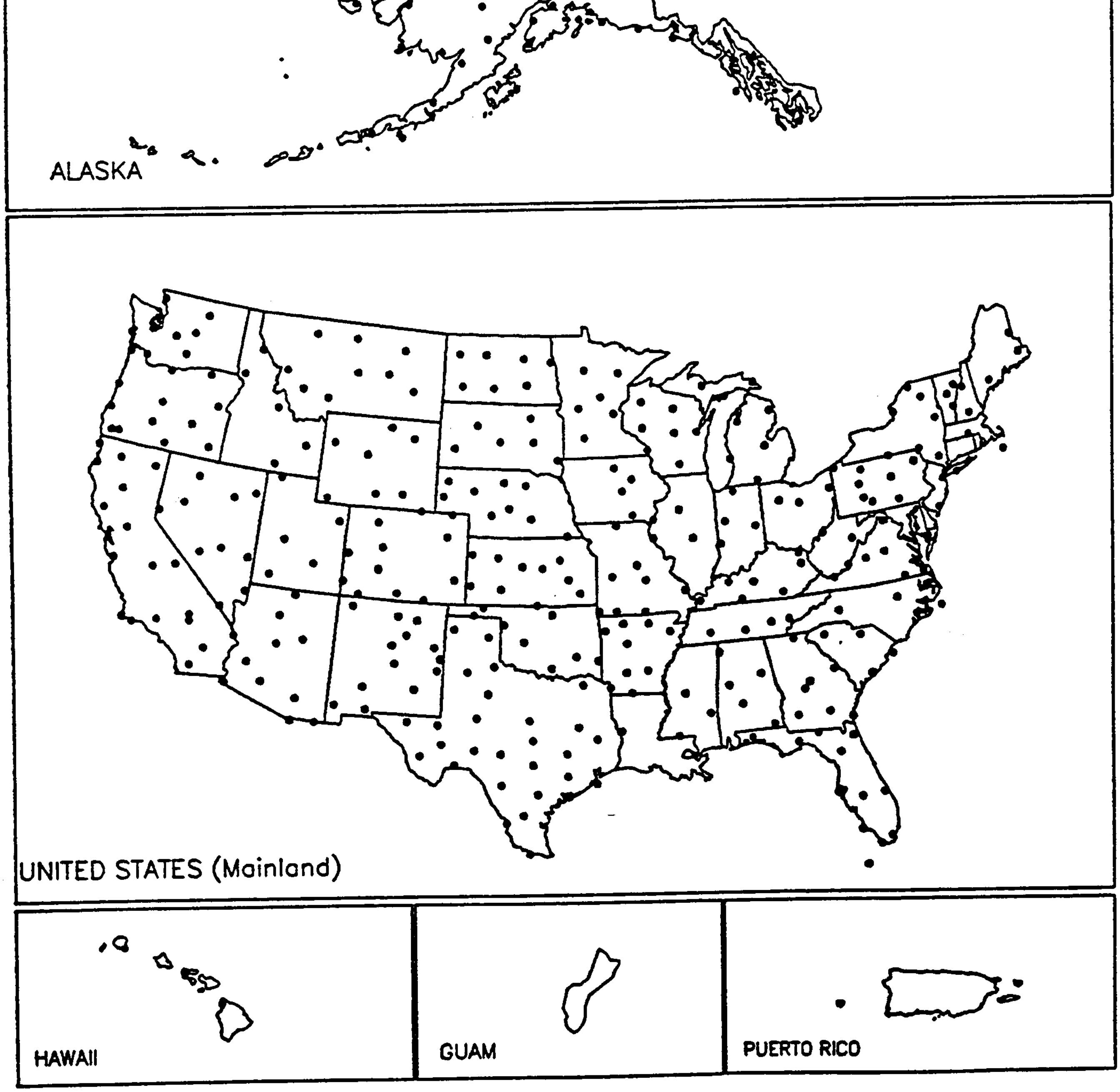
2000 SYSTEM
VHF OMNIDIRECTIONAL RANGE AND
VHF OMNIDIRECTIONAL RANGE TEST



2000 SYSTEM
NONDIRECTIONAL BEACON



1990 SYSTEM
INSTRUMENT LANDING SYSTEMS

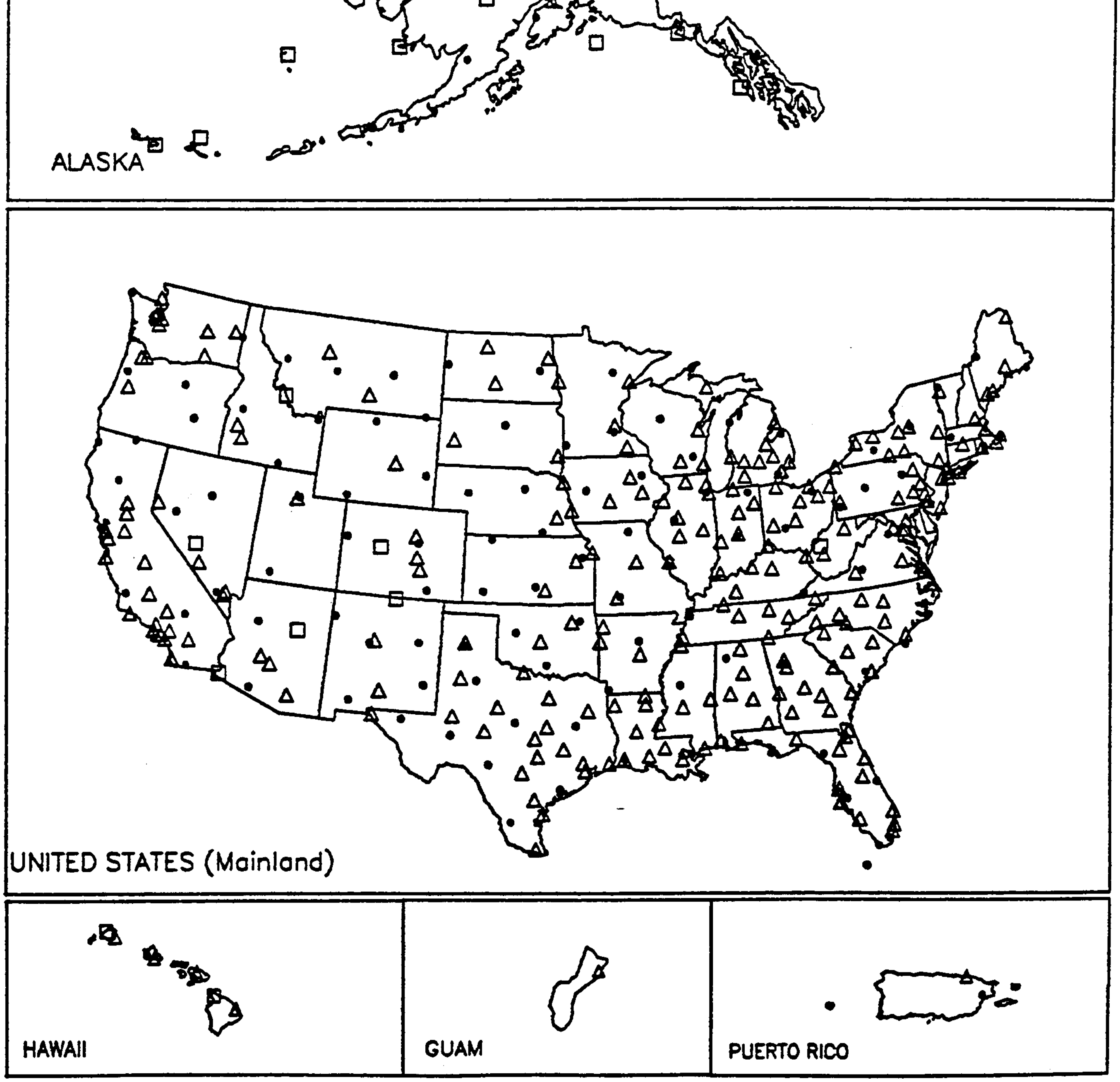


2000 SYSTEM
DIRECTION FINDERS

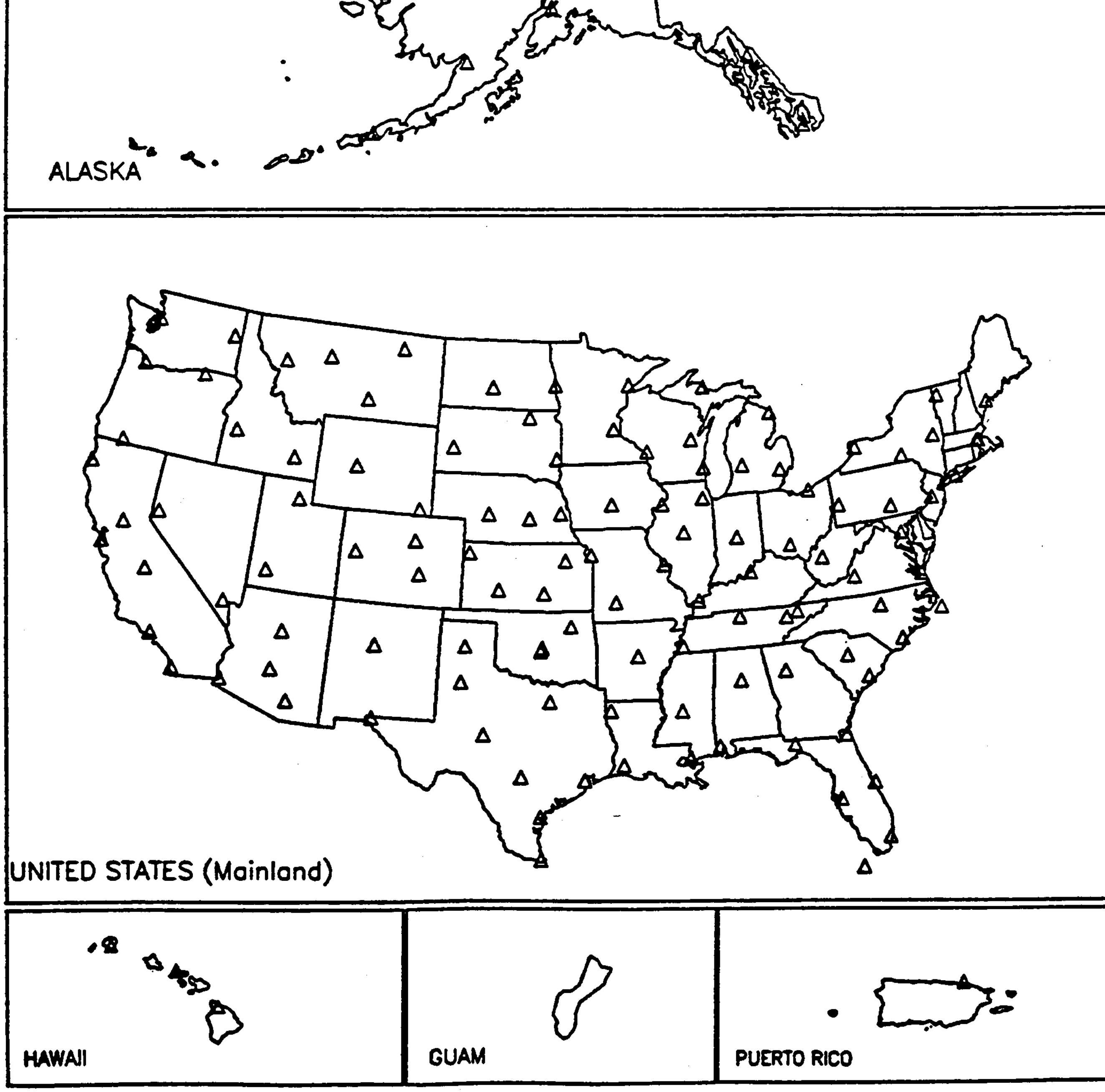
△ AIRPORT SURVEILLANCE RADAR SITES

● LONG RANGE RADAR SITES

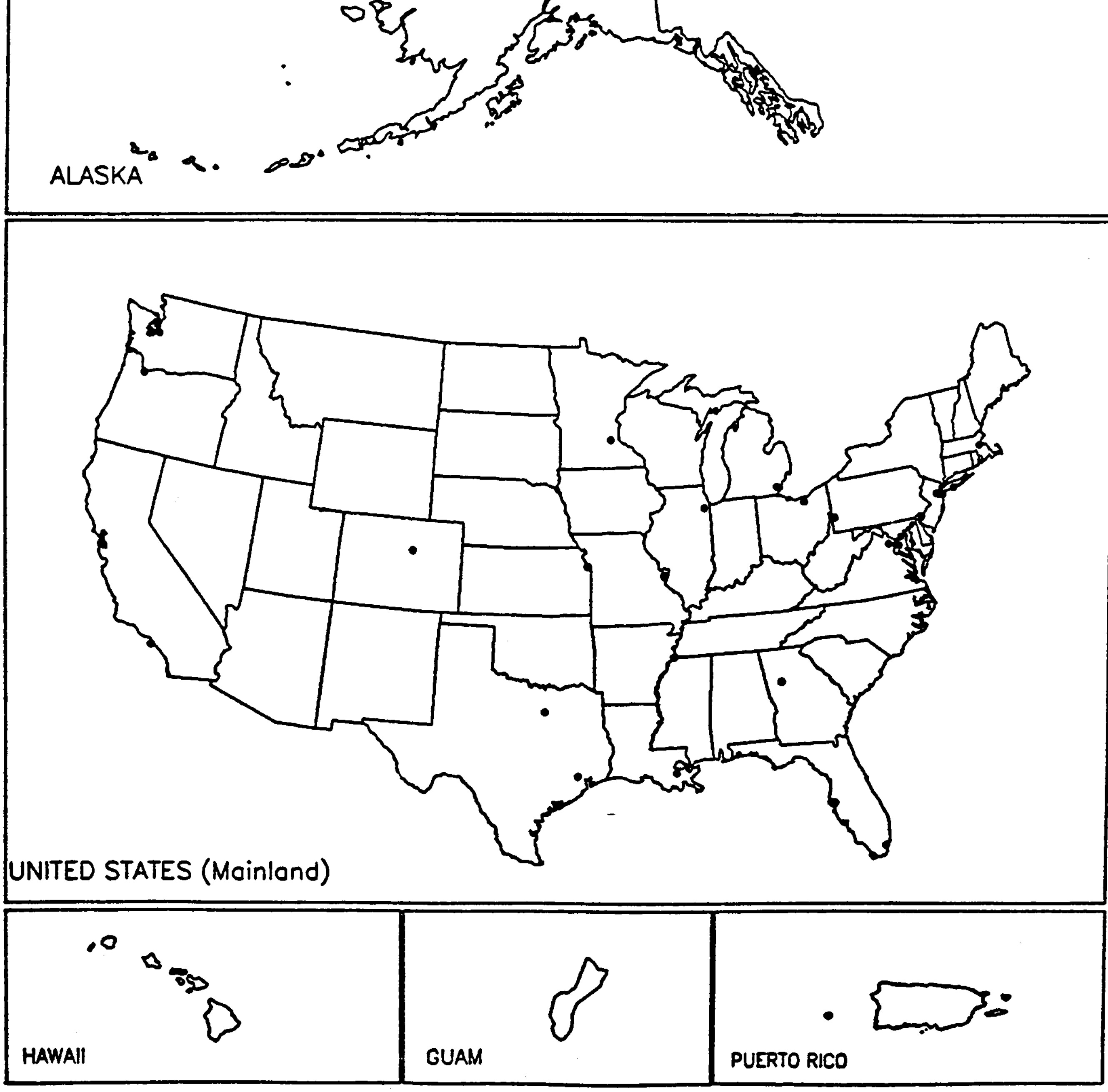
□ BEACON-ONLY SITES



2000 SYSTEM
SURVEILLANCE NETWORK

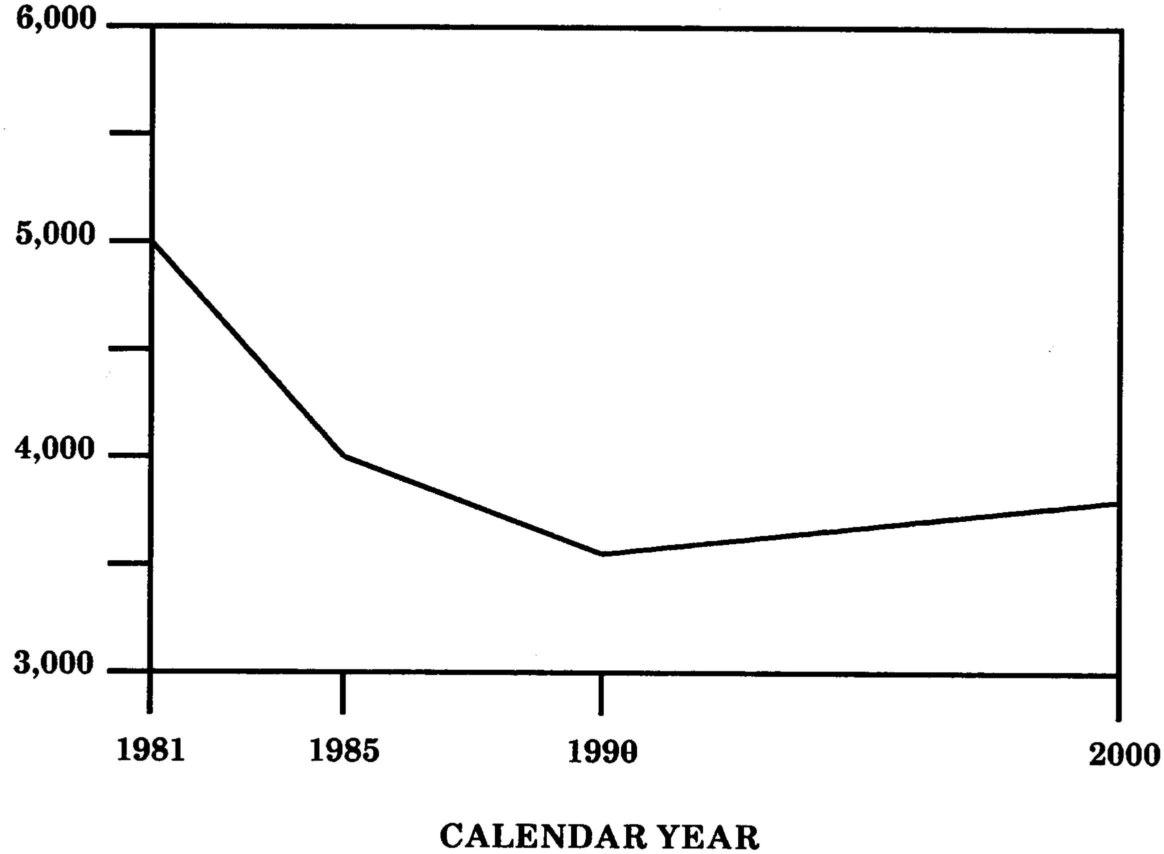


2000 SYSTEM
NEXT GENERATION WEATHER RADAR (NEXRAD) NETWORK



1990 SYSTEM
AIRPORT SURFACE DETECTION EQUIPMENT

not required for these remote systems.



AIRWAY FACILITIES EMPLOYMENT
(GROUND-TO-AIR SYSTEMS)

personnel requirements to 3,985 positions.

1990 – Airway Facilities employment will continue to decrease during this time period in spite of the additional number of facilities established, such as MLS, visual aids, airport surveillance radar (ASR), tion of facilities, and reduction of facilities through networking.

Outyear estimates are reviewed annually and are subject to revision.

GROUND-TO-AIR SYSTEMS
AIRWAY FACILITIES EMPLOYMENT CHANGES
AND CORRESPONDING PERSONNEL COSTS
(1981 Dollars)

	1981	1985	1990	2000
Operations (Millions)	151.5	143.5	146.1	185.1
Airway Facilities Personnel	5,057	3,985	3,526	3,776
AF Productivity Quotient	29,958	36,010	41,435	49,020
Airway Facilities Personnel Costs (thousands)	$172,444	$135,889	$120,236	$128,762

of the NAS. Moreover, they are bound by the requirement that existing or proposed services are available when and where needed and are tailored to the operational needs of the users within cost constraints.

The communications projects provide voice communication capability required by pilots for en route, terminal, and flight service station operations in a cost-effective manner through solid-state replacement and the formation of an integrated network of facilities.

The navigation projects similarly modernize both VOR and NDB-type ground based navigational aids in use today, ensuring en route safety and cost-effectiveness.

The approach and landing systems projects modernize the electronic aids used by instrumented aircraft and the visual landing aids used by all. weather and ensure aircraft separation in all areas where traffic density warrants such service. Individual projects address long-range radars (ARSR), airport surveillance radars (ASR), and airport surveillance detection equipment (ASDE). The Mode S project modernizes the secondary surveillance radar. It is co-located with ASR and long-range radars and operates with equipped aircraft to provide information on aircraft identity and altitude. The modernization of tube-type ASR, long-range radar, and provision of Mode S data link form an integrated set of projects required to provide the quality surveillance data needed for the operation of the advanced automation system in area control facilities. Since conventional surveillance radar, designed for aircraft detection, detects weather poorly, the weather radar project is included in the set to improve weather detection. Additionally, the direction finder project modernizes that equipment used to locate aircraft outside of radar coverage.

2. Communications Facilities Consolidation/Network	1985	1992
3. VORTAC	1981	1993
4. Nondirectional Beacon (NDB) *	PROJECT COMPLETE	1988
5. Global Positioning System (GPS) Monitors	1995	1997
6. Instrument Landing System (ILS)	PROJECT COMPLETE	1989
7. Microwave Landing System (MLS)	1988	2004
8. Runway Visual Range (RVR)	1988	1994
9. Visual Navaids	1981	1993
10. Approach Lighting System Improvement Program (ALSIP)	1981	1992
11. Direction Finder (DF)	1982	1993
12. Mode S	1992	2000
13. Terminal Radar (ASR) Program	1989	1993
14. Airport Surface Detection Equipment (ASDE 3) Radar	1990	1993
15. Long Range Radar Program	1988	1996
16. Weather Radar Program	1990	1996
17. LORAN C Systems	1991	1992
18. Terminal Doppler Weather Radar (TDWR) System	1993	1996

* Depot Delivery Dates

PROJECT SUMMARY

emergency communications (BUEC)).

- The consolidation and relocation of remote communication facilities will result in the establishment of communication facilities which serve the combined needs of air traffic control and flight service station facilities.

- Consolidation of these facilities into FAA-owned facilities is one step in FAA's program to provide a modern solid-state remote-monitored radio communications network. These efforts result in cost-savings and cost-avoidance through reduced land leases, reduction in maintenance and maintenance travel, reduced power consumption (heating and air conditioning for separate buildings), and reduction in leased services.

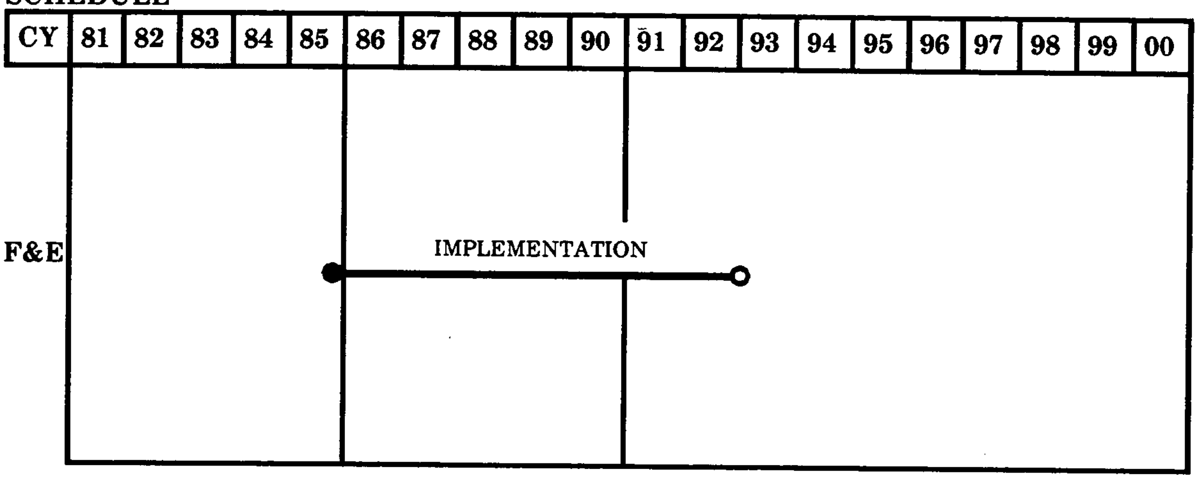
Approach: Multiple RTR facilities at many airports will be consolidated as solid-state receivers and transmitters are installed. FSS communications not already at VORTACs will be consolidated at selected FAA-owned facilities. New and existing RCAGs will be co-located with other FAA-owned facilities. A frequency interference study is required prior to combining large numbers of transmitters and receivers. Development of receiver multicouplers and transmitter combiners is needed to reduce the

In certain specifically defined areas, coverage will be required to or approaching ground level.

Products: Although the communications networking plan has been completed, each region must complete benefits/cost analysis for proposed consolidations. For planning purposes, 2100 facilities is being used as the estimate to be achieved by the year 2000.

Related Projects/Activities: Solid-state transmitter/receiver and radio control equipment must be implemented to avoid relocation of obsolete equipment. The navaid, DF, and radar networking plans and the National Airspace Review are required to finalize facility topology. These consolidated facilities will include RMM capability for channels with radio control equipment installed. Electromagnetic compatibility (EMC) studies have been conducted and EMC guidelines have been developed for consolidated sites. This project will require interfacility communications service from the NICS. That service will be provided through the RML Replacement and Expansion project. Continuing effort beyond 1992 will be provided by the Sustained National Airspace System Support project in Chapter VII.

SCHEDULE



- Replacements. From FY 82 through FY 89 the FAA replaced 950 vacuum tube-type VOR and VORTAC systems with modern solid-state equipment. New RMM compatible DME systems will replace existing DME systems at 40 VOR/DME sites. The units removed from these sites will be redeployed to ILS sites. 77 tube-type VOTs will be replaced with solid-state equipment. VOT equipments will be replaced with solid-state equipment.

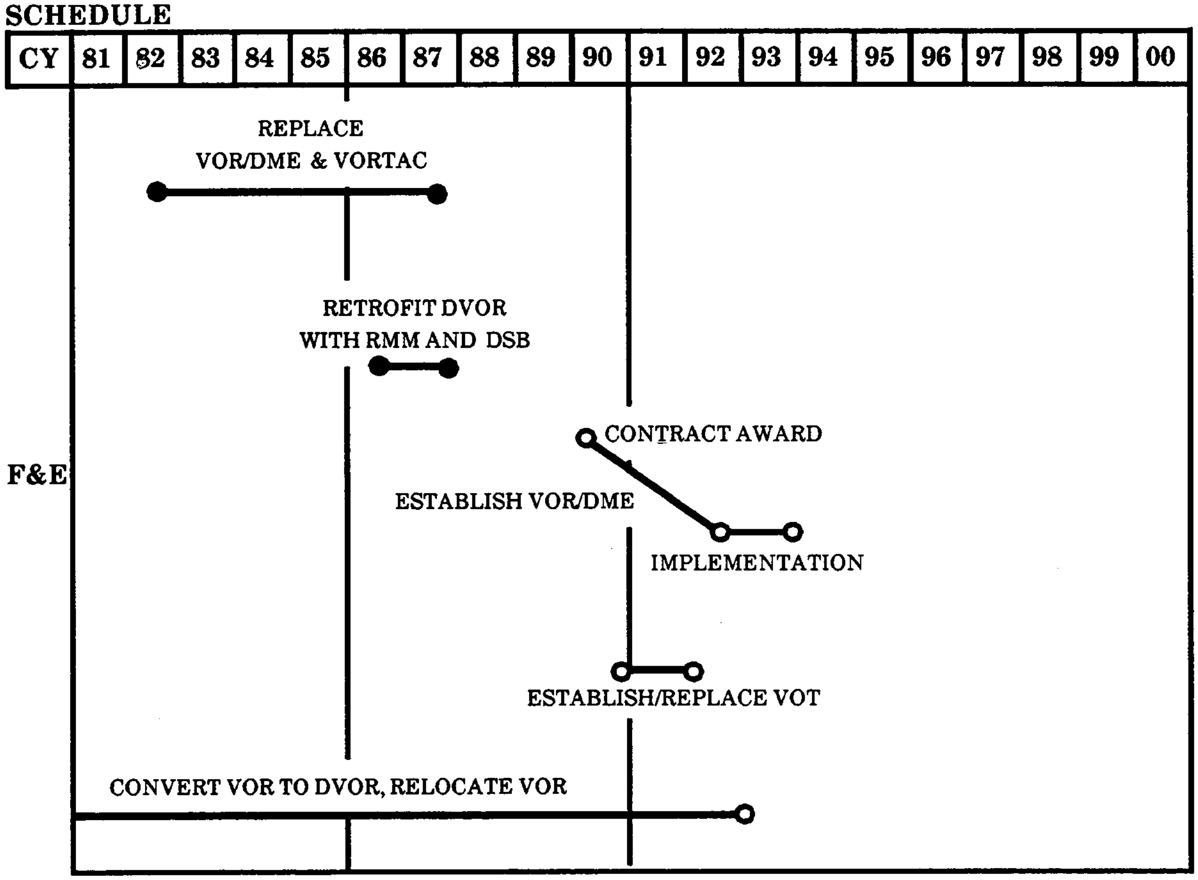
- Relocations. VOR/DME facilities will be relocated to accommodate route structure changes, real estate considerations and site suitability.

- Conversions. Conventional VORs will be converted to Doppler VORs to solve siting problems and to obtain required signal coverage.

- Establishments. Operational requirements that arise in various geographic areas require the establishment of VHF navigational aid services. Provisions have been made to establish 70 VOR/DME sites including new VOR/DME equipment at non-Federal takeover locations. DME systems will be added at 47 sites equipped with VOR only. As many as 35 VOT sites may be established.

	1981-1985 Quantity	1986-1990 Quantity	1991-2000 Quantity
Replace VORTAC	725		
Replace VOR/DME	145		
Replace VOR	80		
Establish VOR/DME			70
Establish DME at VOR			47
Replace DME at VOR			40
Reinstall DME at ILS			40
Convert VOR to DSB DVOR		15	25
Retrofit DVOR with RMM & DSB		50	
Establish VOT		35	
Replace VOT		77	

SCHEDULE


CY
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F&E
REPLACE
VOR/DME & VORTAC
RETROFIT DVOR
WITH RMM AND DSB
CONTRACT AWARD
ESTABLISH VOR/DME
IMPLEMENTATION
ESTABLISH/REPLACE VOT
CONVERT VOR TO DVOR, RELOCATE VOR

relocation.

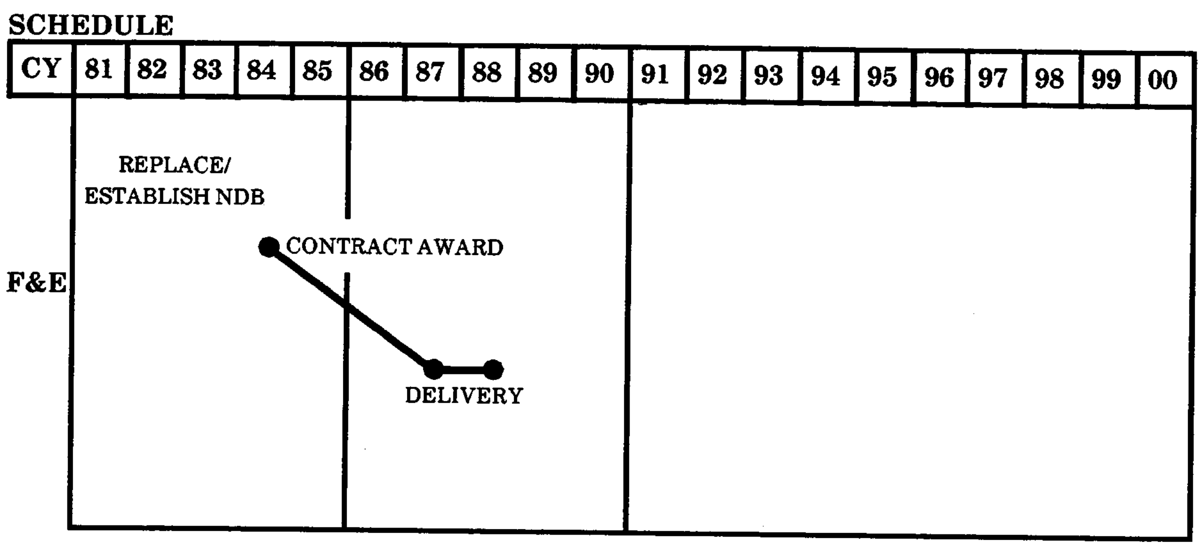
Existing tube-type systems are manpower-intensive and very costly to support. New systems will provide savings in energy consumption, improve reliability/availability, and reduce site visits. At selected sites, NDBs with RMM capability will be installed.

Approach: Establish and replace NDBs and add RMM as appropriate. The establishment of additional facilities on a non-interfering basis, within a limited radio frequency band, may require that individual site bandwidths be narrowed. This will eliminate the NDB's voice feature.

- Both terminal and en route NDBs are included.

Related Projects/Activities: Locations and total numbers of NDB facilities will depend on network studies. Frequency and spectrum management aspects of co-located facilities must be considered. This project will require interfacility communications service from the NICS. That service will be provided through the Data Multiplexing project. Selected NDBs will be monitored at the maintenance control centers via the remote maintenance monitoring network. Continuing effort beyond 1992 will be provided by the Sustained National Airspace System Support project in Chapter VII.

PROJECT COMPLETE



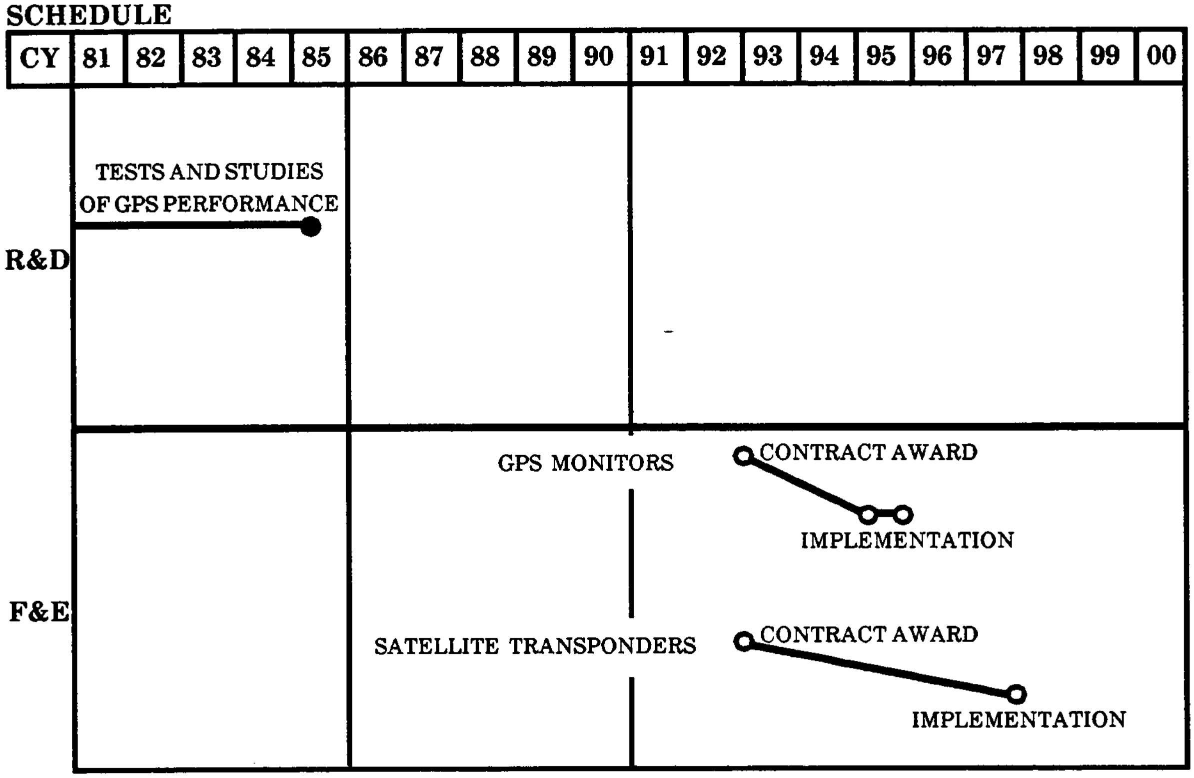
system.

Use of any navigation aid in the NAS by civil aviation requires FAA approval. Beyond the approval of avionics performance, it is necessary for the FAA to monitor GPS satellite signals in order to be immediately aware of the operational status of the

Products: Six GPS monitors will be deployed in 1994/1995.

Related Projects/Activities: This project will require interfacility communications service from the NICS.

SCHEDULE



facilities which permit landing operations with 100-foot decision height and 1,200 feet runway visual range.

Additionally, FAA plans for implementation of the microwave landing system (MLS) include an extensive transition period. During this period, the present conventional instrument landing systems must continue in operation to provide time for the aviation community to equip their aircraft with the required avionics and to allow for MLS ground equipment procurement and deployment. To avoid increasingly difficult and costly support problems, it is planned, in the interim period, to replace tube-type components of approximately 263 instrument landing systems.

Approach:

- Category I Establishment. New ILS equipment establishment will be kept to a minimum in line with FAA's plans for early implementation of MLS.

- Replacement. Tube-type ILS equipment will be replaced at those airports which are not scheduled to receive MLS equipment prior to 1990. A portion of these replacements is being accomplished using equipment or funds recovered from ILS establishment projects that were reprogrammed to MLS. A portion is being provided by a modification to the ongoing ILS contract and the balance is to be provided under the contract for ILS components.

- Category II Establishment. There were two Category II locations in the FY 85 budget which received their equipment from this ILS project. New Category II sites required the concurrent

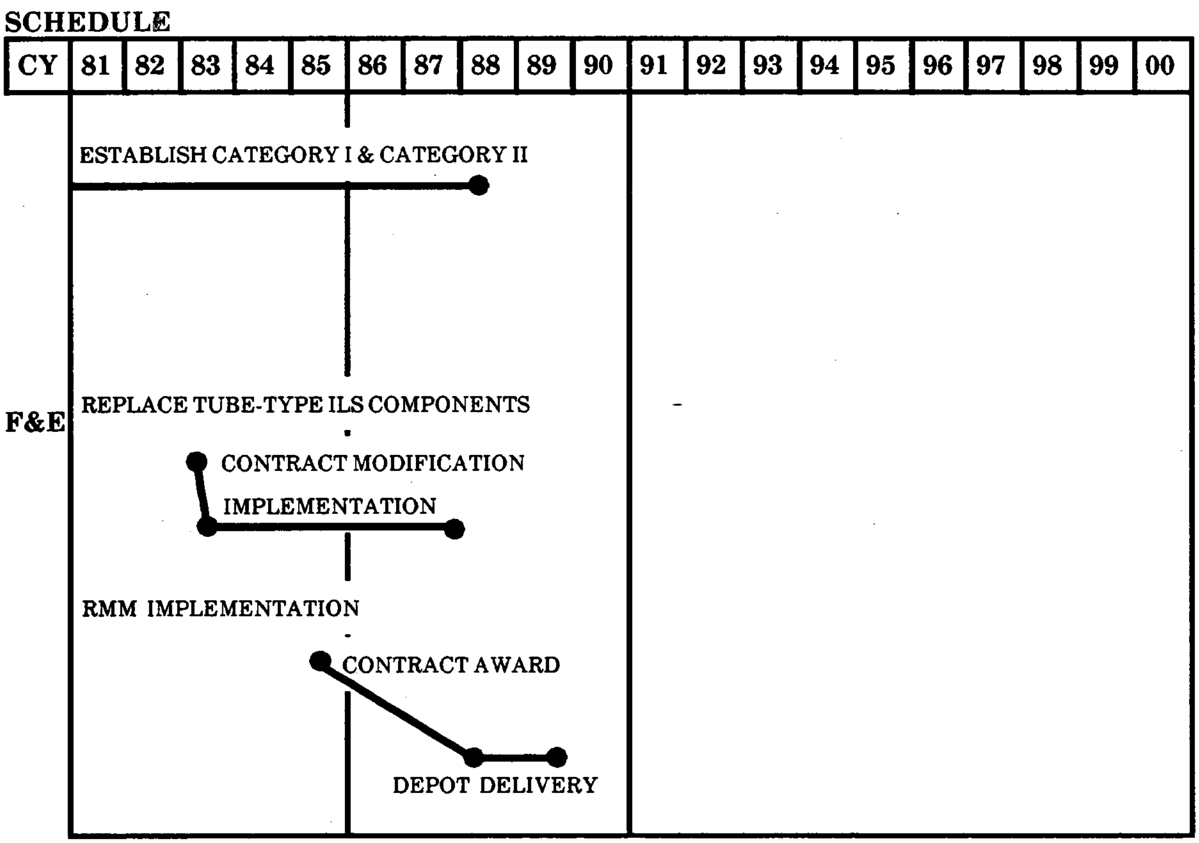
– Full systems.	22
– Partial (localizer).	3
– Glide slope.	10
● Replace Tube Type.	
– Localizer and glide slope.	193
– Localizer or glide slope.	70
● Establish Category II.	
– Full systems.	2

Related Projects/Activities: Additional ILS systems will be provided under Project 7-11, Supplemental Instrument Landing Systems. Qualifying solid-state ILS systems will be retrofitted with remote maintenance monitoring. Qualifying facilities will receive medium-intensity approach lighting systems with runway alignment indicator lights (MALSR) and/or runway visual range (RVR). NAS spectrum engineering support is required for ILS establishment to ensure interference-free operation.

Seventy-five AN/GRN-27 ILS systems will be replaced under projects in Chapter VIII (65 under ILS Replacement and 10 under Interim Support Plan).

Upgrade kits and antenna systems need to be procured to allow the ILS to continue to meet the requirements of the NAS through the year 2000. Supply support requirements need to be addressed during this interim period due to the critical short fall in stock items availability for ILS. Examples are: localizer arrays, distribution boxes, cables, RF sideband reference glide slope kits, capture effect kits for both localizer and glide slopes, and markers.

PROJECT COMPLETE



weather effects, thereby providing low-cost installation in all airport environments. The MLS with RMM capabilities will reduce the maintenance manpower requirements associated with ILS. The MLS provides a radio signal which allows multiple-curved and segmented approaches and selectable glide slope angles when aircraft are equipped with appropriate MLS avionics.

The MLS has the potential to improve NAS capacity. MLS can improve capacity by providing lower IFR minimums; allowing capacity enhancing IMC flight operations; and by providing precision approach services at locations where ILS service is not possible or beneficial. The use of advanced operational procedures to improve capacity is particularly significant in complex multi-airport environments such as metropolitan New York City, Chicago, Dallas-Fort Worth, and San Francisco, and yields benefits unavailable with the ILS.

Approach: In 1984 a multi-year contract was awarded to procure initial quantities of production quality systems. Funding was provided for 15 systems each in FY 82 and FY 83; 28 systems in FY 84 (2 for training and test bed); and 60 systems each in FY 85 and FY 86. The contract was terminated for default without substantial delivery in 1989. Because of the delays and contract termination, the entire program has been restructured and out year schedules are under review. After completion of the evaluation program, decisions will be determined for future procurements.

procedures and obstacle clearance/critical area criteria are being developed to support the implementation process. These include unique MLS capabilities, such as curved and segmented approaches, missed approach and departure guidance, as well as conventional approaches.

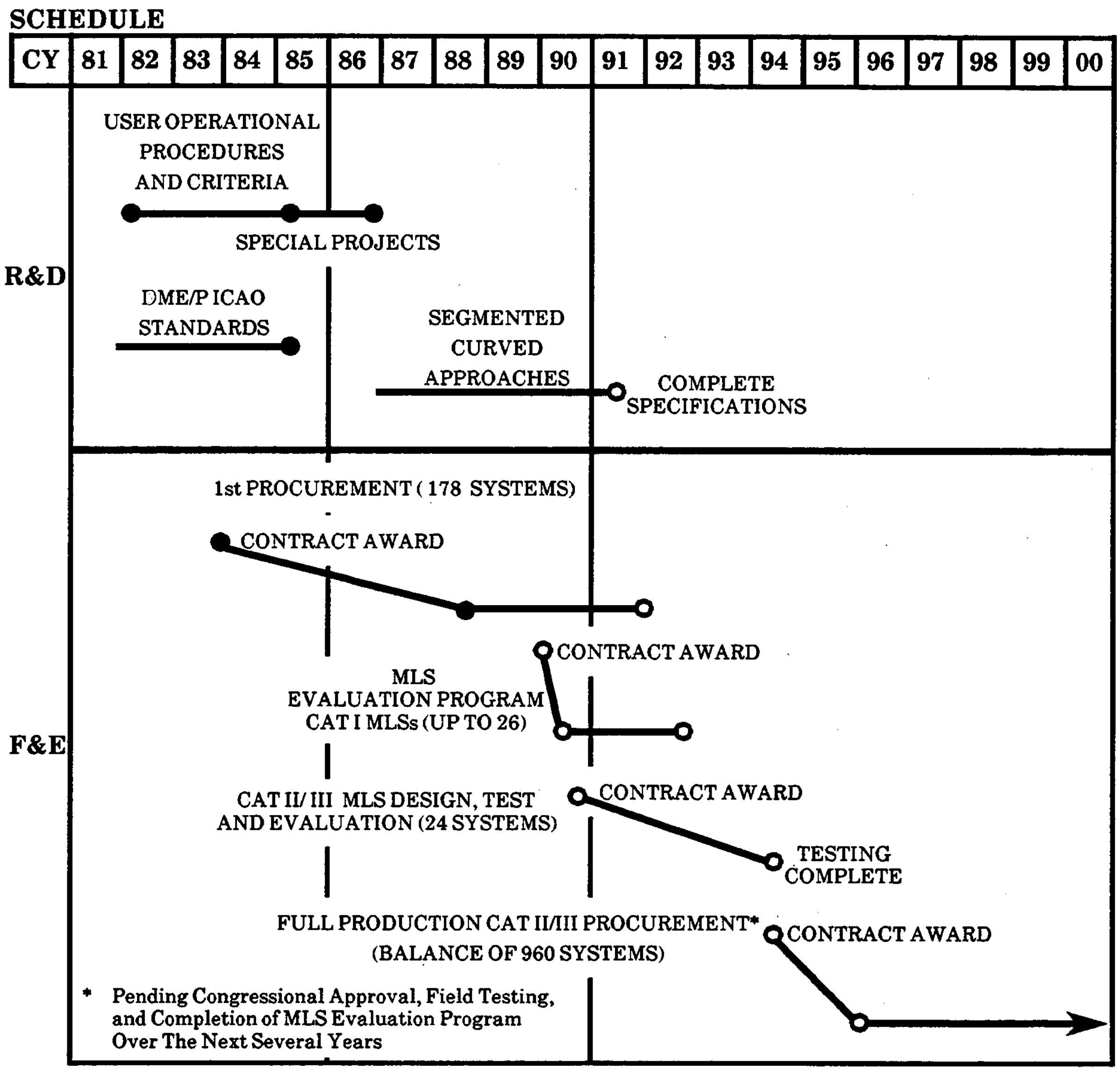
Analyses are being conducted to support ICAO standards for such items as DME/P, auxiliary data, operational criteria and procedures. Also, system specifications will be expanded to incorporate enhanced MLS capabilities (growth features such as 360 degree azimuth).

New Terminal Instrument Procedures (TERPS) criteria applicable to both MLS and ILS are now in place. This criteria permits the design and use of MLS curved approach procedures.

The MLS Program Management Office has developed a nine project MLS evaluation program to evaluate the economic and operational benefits of MLS. This program will provide the basis for obtaining approval to proceed with the CAT II/II MLS production contract.

Products: Up to 960 MLSs are planned to be procured through the year 2000 (subject to the results of the evaluation program). An additional 290 or more MLS procurements are planned after the year 2000. The Department of Defense plans to procure a total of 405 MLSs. Decisions on the exact number of MLSs will be determined after completion of the evaluation program.

PROJECT UNDER REVIEW



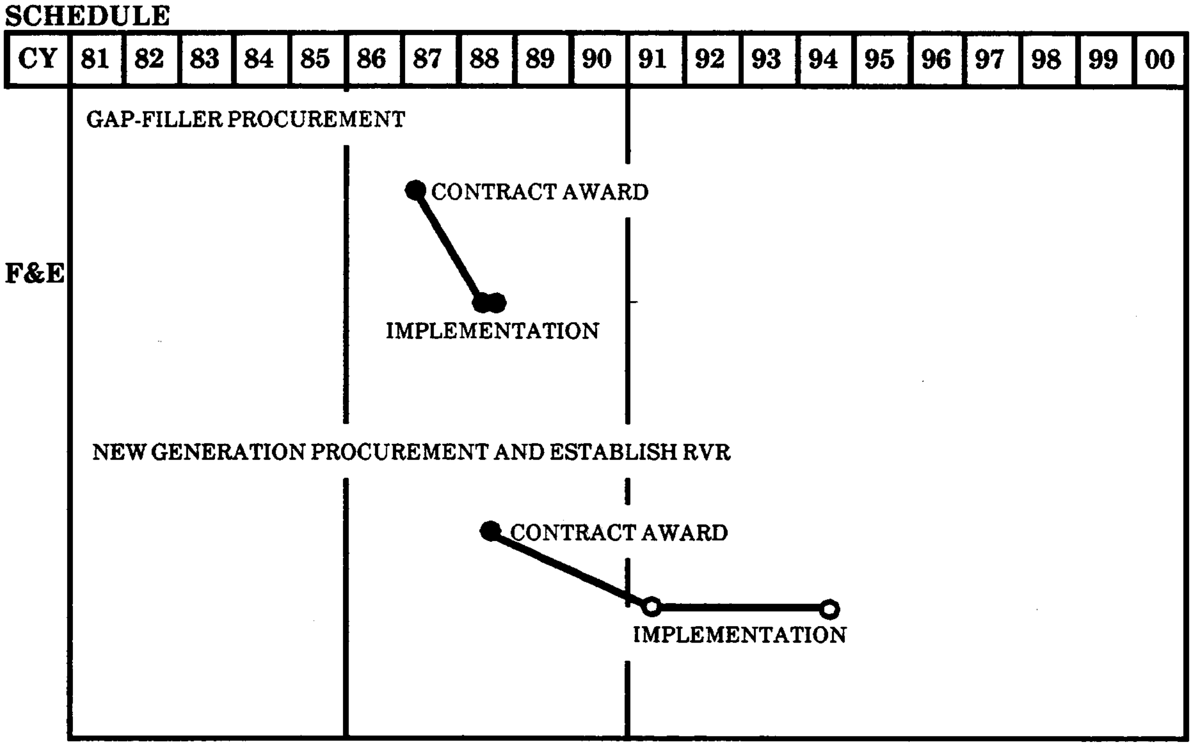
runway lighting intensity and ambient light conditions.

Approach: A new RVR System, employing current technology, will provide an inherent capability to satisfy CAT I thru CAT IIIb requirements. The new RVR System will be fielded to replace all existing RVV and RVR equipments which are maintenance intensive and employ outdated technology. The project will also provide new generation equipment for establishment at qualifying facilities to satisfy instrument landing facility requirements. In light of the time associated with delivery of new

- Establish new locations 97
- Gap Filler Establishment and Replacement 11

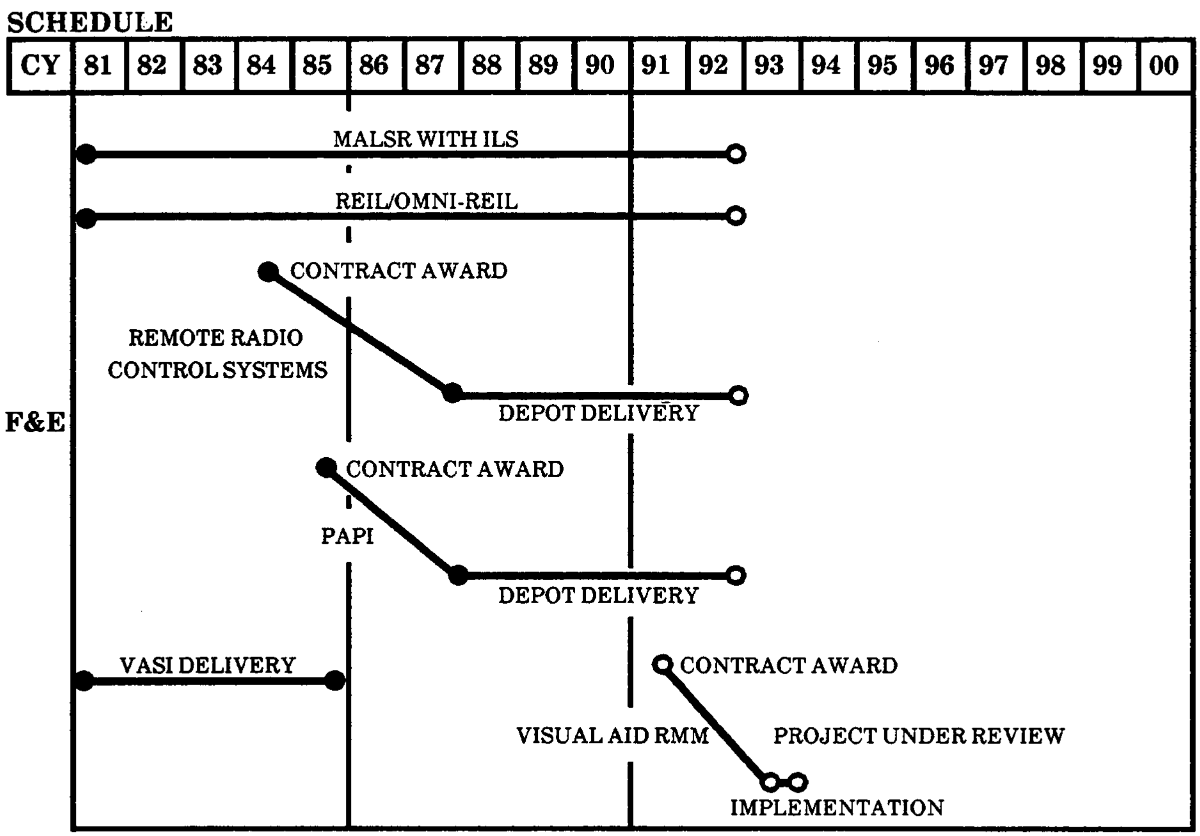
Related Projects/Activities: Instrument Landing Systems and Microwave Landing Systems are related projects. This project and the RVR replacement project described in Chapter VII are designed to fulfill RVR system requirements. Sustaining engineering needs required beyond 1992 will be accomplished under the sustained NAS support project, also included in Chapter VII.

SCHEDULE



This program also provides equipment for the replacement or establishment of remote radio control capabilities for visual aids which will meet the operational requirements of air traffic control and will remove complex manually activated coding methods. The new system will permit single-button control of each visual-aid function.

Related Projects/Activities: This project, when combined with the Approach Lighting System Improvement Program project, will totally modernize the currently installed airport lighting systems. The modernization will result in improved safety and increased energy efficiency for both the approach and guidance lighting systems. Spectrum engineering is required for all radio control retrofits. The Airport Telecommunications and Airport Power Cable Loop Systems are also related projects. Sustaining engineering needs beyond 1992 will be accomplished under the sustained NAS support project in Chapter VII.



tures that collapse or break apart upon impact will reduce damage to an aircraft should it strike an approach light tower structure during departure or landing. This should help reduce the severity of approach and landing accidents. This effort was mandated by FAA Order 1811.4, System Requirements Statement/Acquisition Authorization for the Approach Lighting System Program, signed by the Administrator on June 12, 1979, in response to an NTSB recommendation. The program will also result in a significant reduction in FAA energy consumption and the replacement of outdated and obsolete equipment.

Federal air regulations authorize a pilot to descend below the published minimum descent altitude or decision height, provided that visual references (e.g., approach lights, threshold lights) for the intended runway are distinguishable. The installation of threshold light bars as part of the existing medium-intensity approach lighting system with runway alignment indicator lights (MALSR) will provide a visual reference to the runway threshold and make the present system more effective in low-visibility conditions. The modification will enhance safety and comply with ICAO minimum requirements.

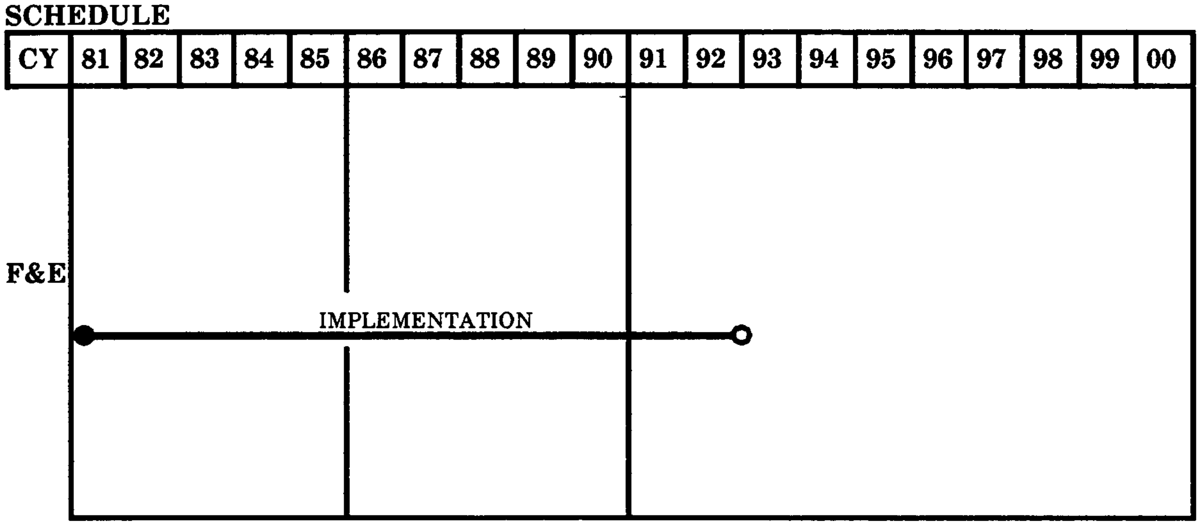
systems with sequence flashers. When the program is fully implemented, energy consumption of these systems will have been reduced by 60 percent over FY 76 base-year requirements; and approach lighting systems will be of two standard types -- ALSF 2 and MALSR.

Products:

- 205 SSALF, SSALR, and ALSF 1 systems will be converted to MALSR.
- 68 ALSF 2s will be provided with low-impact resistant structures and the capability to switch to SSALR configuration.
- 182 MALSRs will be placed on low-impact resistant structures.
- 384 existing MALSRs will be provided with threshold lights.

Related Projects/Activities: This project, when combined with the Visual Navaids project, will totally modernize the currently installed airport lighting systems. The modernization will result in improved safety and increased energy efficiency for both the approach light and guidance lighting systems. Sustaining engineering needs beyond 1992 will be provided for in the sustained NAS Support project in Chapter VII.

SCHEDULE



and cost avoidance by reducing power consumption and maintenance requirements.

Approach: The existing tube-type DF equipment will be replaced with new solid-state equipment which has remote maintenance monitoring, control, and certification capabilities.

In areas where present DF equipment does not provide complete coverage, new sites will be established and co-located with existing FAA

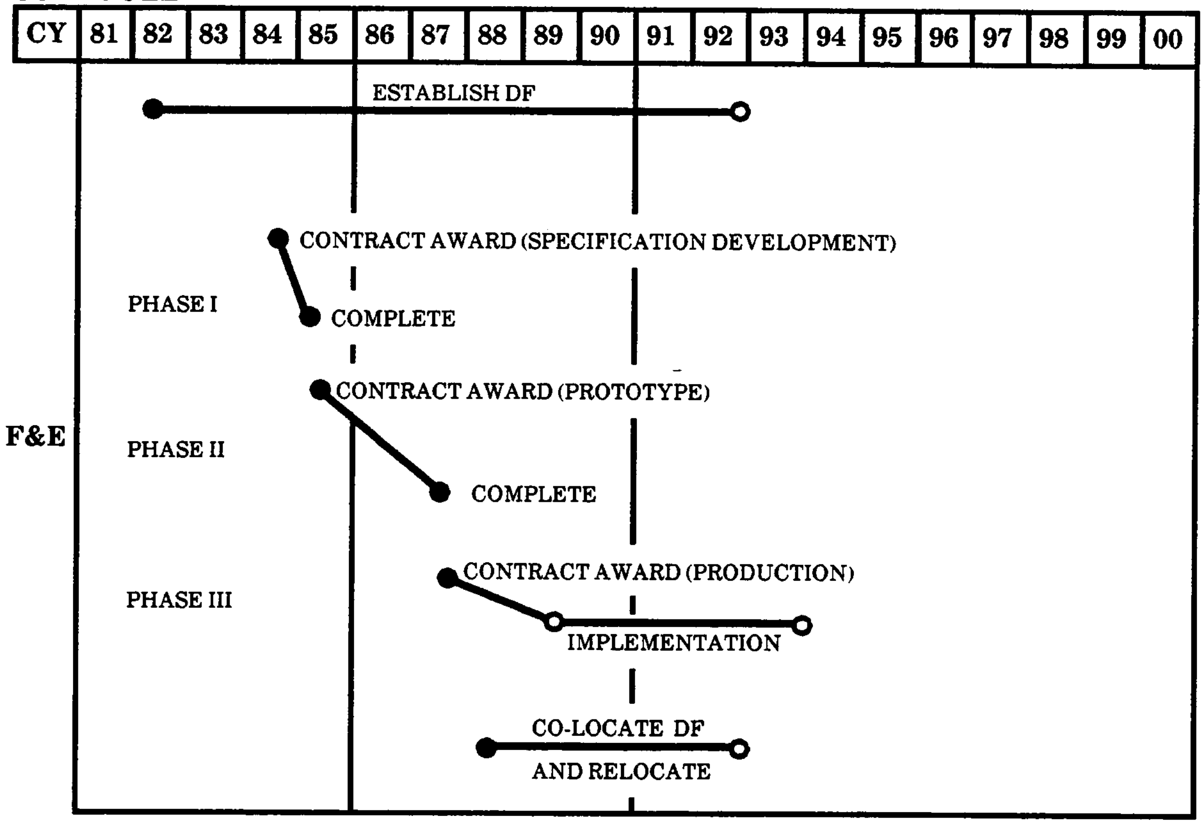
- 300 operational DF systems, of which 175 will be replacements.

- 66 new establishments.

- 3 support systems for the FAA Aeronautical Center.

Related Projects/Activities: DFs will be co-located with communications equipment, depending on the results of facility consolidation activity. FSAS is also a related project.

SCHEDULE

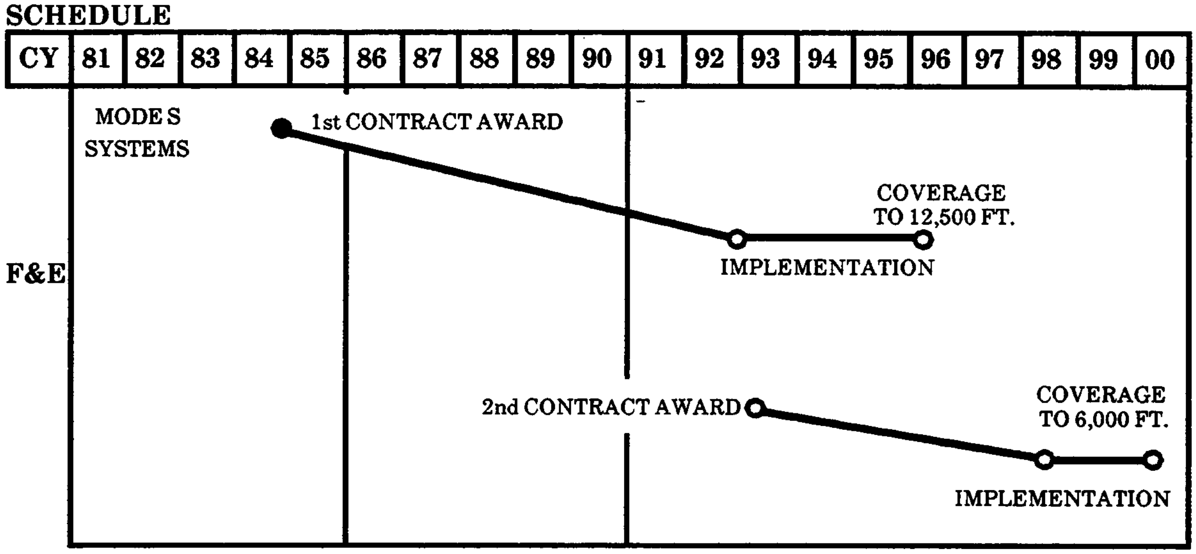


data link which will be used to exchange information between aircraft and various ATC functions and weather data bases.

Approach: Required Mode S systems will be procured using multiple contracts. The first contract for 137 systems will provide coverage down to the ground at 108 terminals and down to 12,500 feet above mean sea level (MSL) in other areas. The second contract, shared with the ATCBI Replacement and Establishment project, will provide an additional 60 systems to this project and will extend the coverage down to 6,000 feet MSL or minimum instrument flight rules en route altitude and above, whichever is higher. The systems are designed to be remote maintenance monitored and unmanned. Existing ATCRBS antennas not already capable of improved azimuth resolution will be replaced and/or additional antennas procured where increased data rates are required.

Related Projects/Activities: The traffic alert and collision avoidance system (TCAS) utilizes Mode S data formats and frequencies. Mode S will be an RMM system. AAS software (AERA) will use Mode S data link for transmitting data from ACFs to aircraft. This project will require telecommunications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing. The DLP will use the Mode S data link to transmit weather data to aircraft. Most terminal and en route surveillance radars will be co-located with Mode S and share a digital interface with the ATC automation system. Spectrum Engineering is required to assure interference-free operation. This project shares a production contract with the ATCBI Replacement and Establishment project.

SCHEDULE



ability for the ASR 4/5/6 radars is critical.

Approach: Three separate activities have been combined to form this program.

- Replacement of 96 ASR 4/5/6 vacuum-tube radars with ASR 7/8/9 (leapfrog 16 ASR 7s to ASR 4/5/6 sites, leapfrog 40 ASR 8s to ASR 4/5/6, and install 40 ASR 9s at ASR 4/5/6 sites).

- Procurement of ASR 9 systems to provide radar service at airports where the air traffic volume increases to a level requiring the coverage.

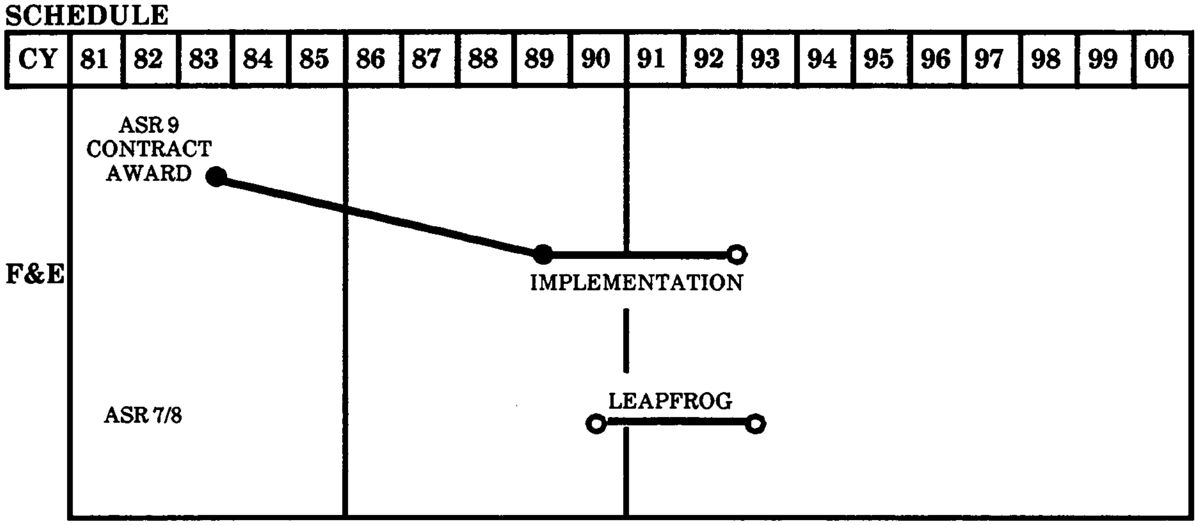
- Relocation of existing solid-state radars (ASR 7/8) where necessary due to new construction interfering with required radar coverage or to changes in air traffic volume.

Data from ASR 9 radars will be remoted in digital format only. At the indicator site, the data will be available in digital and analog format.

- Remote data from some terminal radars based on coverage requirements that will exist prior to ACF implementation.

Related Projects/Activities: ASR 9 installations are planned to precede Mode S installations and must be coordinated. Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for pulse repetition frequency (prf) and frequency. ARTS IIA software changes will be required to interface with the ASR 9. Changes to ARTS IIIA software will not be required to accept ASR 9 digital data. This program will require interfacility communications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing.

SCHEDULE



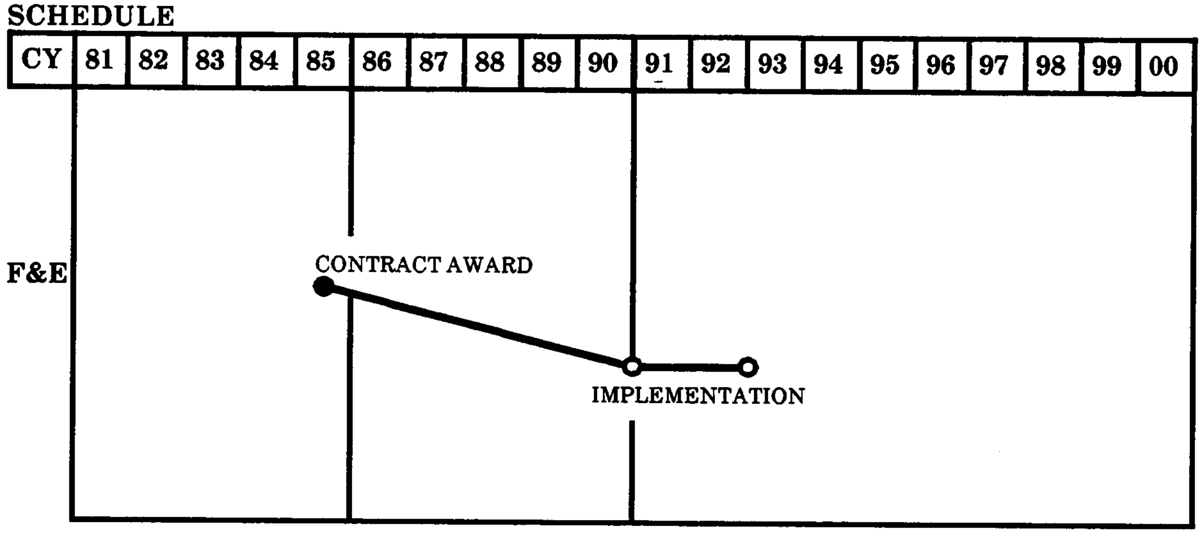
such as rain, fog, and night operations.

Approach: A specification has been developed which details a ground surveillance radar that will map the airport complex and identify aircraft or service equipment locations and movement. A contract was awarded in 1985. An option to this contract was exercised in 1988 to provide additional sensors.

satisfy the requirement for three dual sensor systems.

Related Projects/Activities: ASDE 3s will be remote maintenance monitored. Frequency and spectrum engineering is involved with the ASDE 3 implementation.

SCHEDULE



be safely afforded to all users of the airspace. This data can be made available by radar surveillance information.

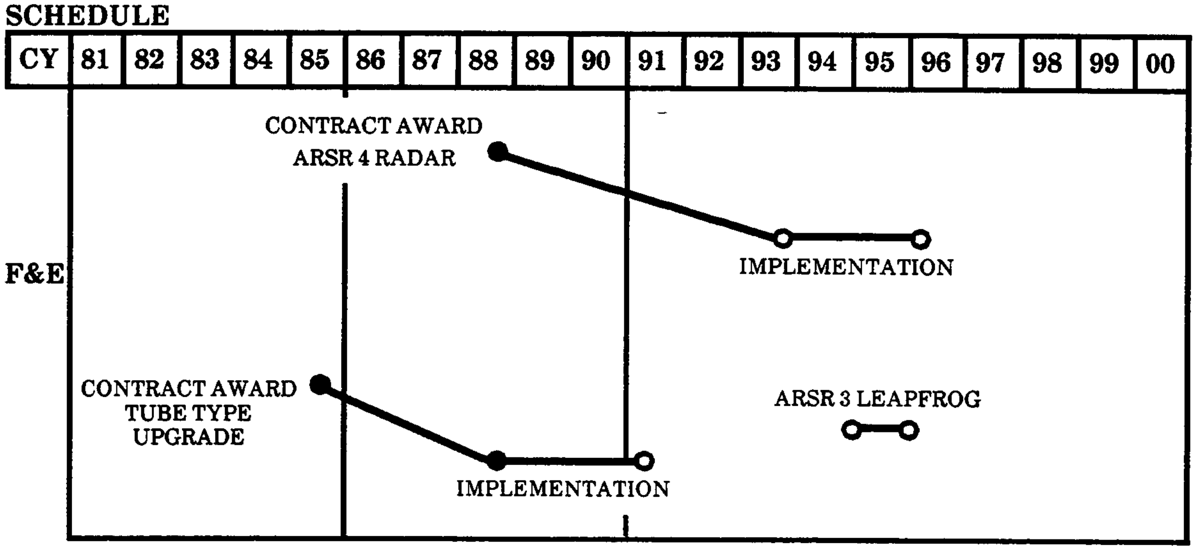
This replacement/upgrade program will significantly reduce maintenance workload and logistics costs, as well as resolve problems relating to nonavailability of spare parts for the existing old radars.

Approach: Replace selected portions of vacuum-tube radars with solid-state devices. Repair and refurbish other portions and improve tolerance to power fluctuations. Provide limited remote control. These steps are necessary to extend the usable life of the vacuum tube-type radars until the national network can be implemented. RMM will be provided for all ARSR 3 facilities.

- 11 ARSR 3 leapfrogs.
- Long range radar relocations as required.
- 76 upgraded en route tube-type radars.

Related Projects/Activities: Frequency and spectrum engineering is involved with the Terminal Radar, Long Range Radar, and Weather Radar Programs since these systems compete for prf and frequency assignments. This program will require telecommunications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing will be remotely monitored from an MCC. Mode S is planned to be co-located and interfaced with the radars. The advanced automation system will receive target and beacon data from the radars.

SCHEDULE



and fuel efficiency. In addition to the improvements to be gained in today's system, future automated ATC functions, such as AERA and improved flow management, must have reliable and accurate weather data before maximum fuel efficiency and manpower productivity gains projected for these improvements can be realized.

Approach: This program consists of the definition, development, procurement, and installation of a new Doppler weather radar for en route applications. The long-range Doppler weather radar for en route applications, known as the next generation weather radar (NEXRAD), is being funded jointly by the Department of Commerce (60 percent), the Department of Defense (20 percent), and the FAA (20 percent).

The NEXRAD full production option will be exercised following procurement of the initial 10 units. The number of NEXRAD units are being determined by the Department of Commerce, Department of Defense, and the FAA. Interim display capability will be provided to support operation prior to central weather processor (CWP) availability. A NEXRAD Communications Interface Unit (NCIU) Network will be provided to distribute weather products.

- – NWS support 2

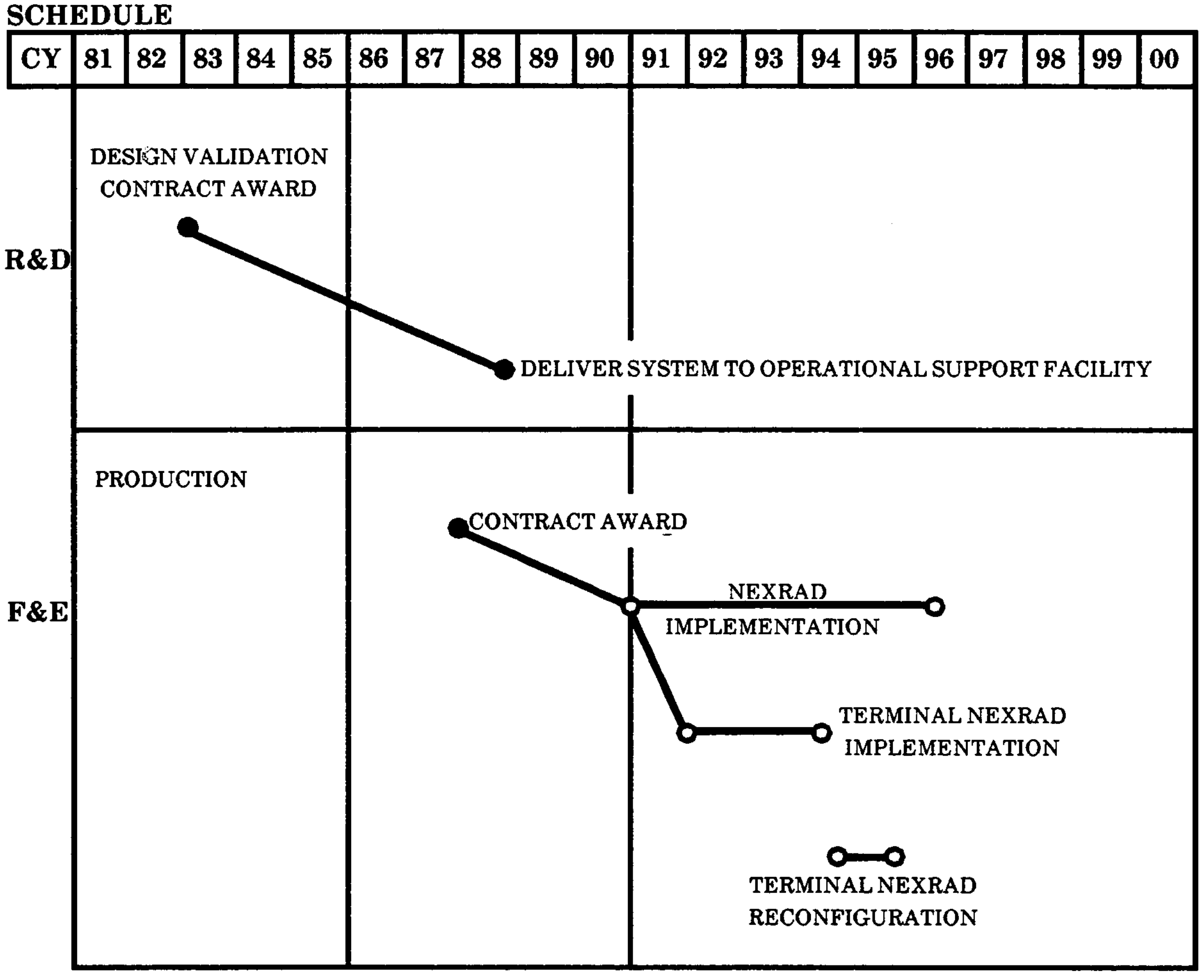
- NEXRAD Communications Interface Unit (NCIU) Network 1

- Displays and processors for ARTCCs 23

Up to seventeen of the above NEXRAD units will be configured for terminal operation to provide early operational capability and experience with Doppler weather radar in the terminal area. After terminal Doppler weather radars (TDWRs) are implemented 13 of these units will be redeployed to non-conus locations with the remainder to be deployed as terminal NEXRADS.

Related Projects/Activities: CWP and leased communications are related activities. FAA non-CONUS NEXRADs will be remote maintenance monitored. Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for prf and frequency.

SCHEDULE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DESIGN VALIDATION CONTRACT AWARD
DELIVER SYSTEM TO OPERATIONAL SUPPORT FACILITY
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PRODUCTION
CONTRACT AWARD
NEXRAD IMPLEMENTATION
TERMINAL NEXRAD IMPLEMENTATION
TERMINAL NEXRAD RECONFIGURATION

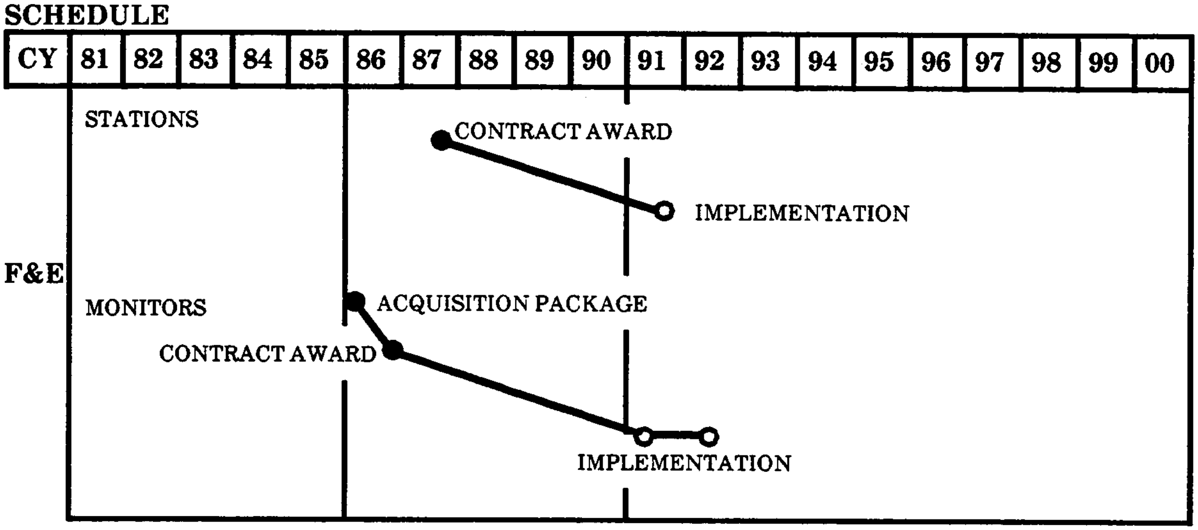
attractive for general aviation and rotorcraft operations. LORAN C is intended as a supplemental radio navigation system for aviation use providing at least single-level coverage for en route and terminal IFR navigation for the contiguous United States. Additionally, nonprecision approaches will be supported where signal requirements are met.

be an FAA responsibility.

Products: Four LORAN C stations will be required to complete single-level signal coverage for the 48 contiguous states. There will be 212 monitors provided to support nonprecision approaches, training, logistics, and field support.

Related Projects/Activities: This project will require telecommunications service from the NICS.

SCHEDULE



Microbursts are a weather phenomenon that consists of an intense downdraft that may occur in clear air or in precipitation areas and are particularly dangerous to aircraft landing or departing. The TDWR scanning mode will be optimized for microburst/wind shear detection. The radar will be located near or on the airport.

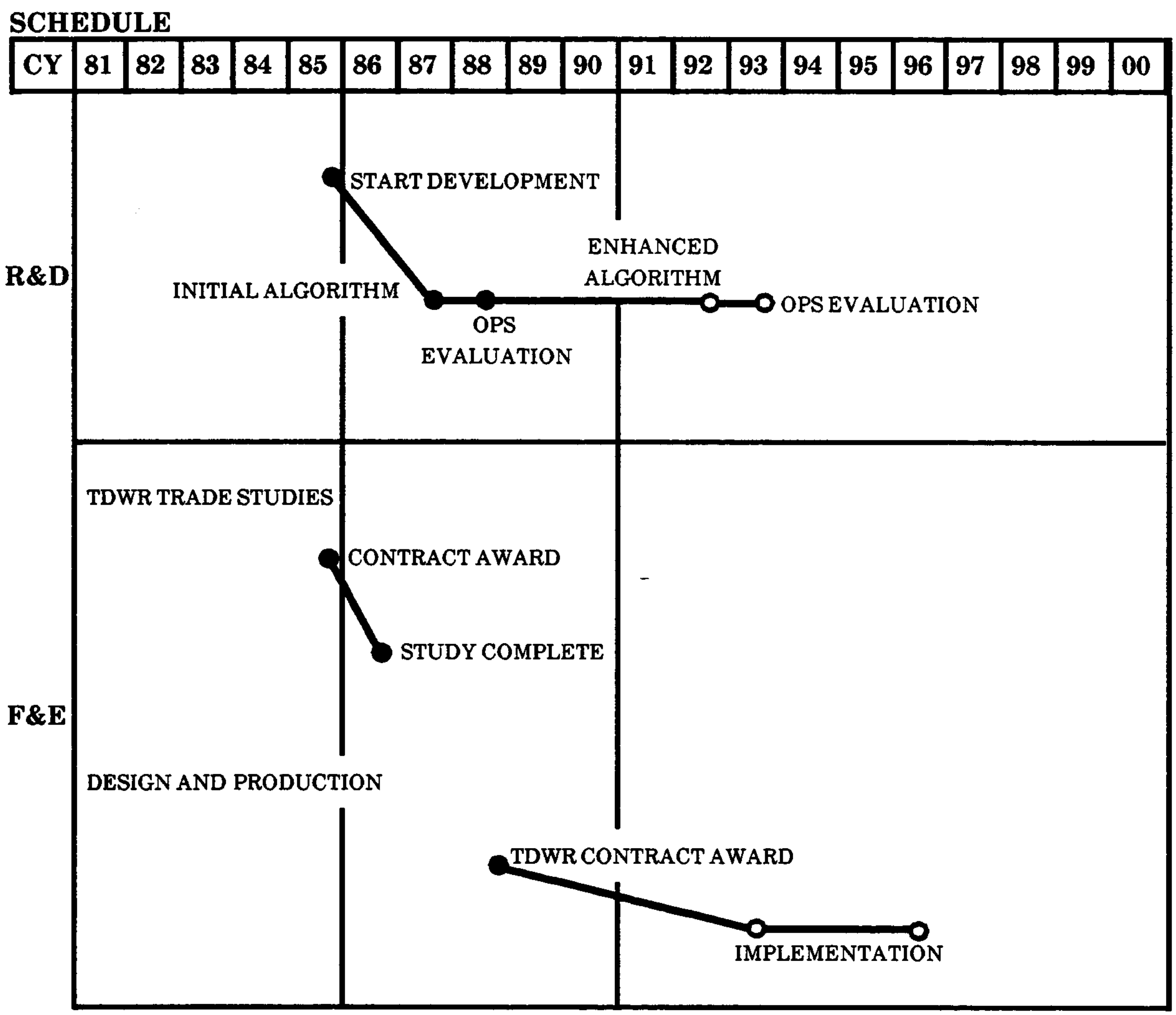
Approach: Trade studies that examined alternative designs, frequency comparisons and other design considerations have been completed by the two NEXRAD development contractors. Data from these studies contributed toward TDWR specification development.

TDWR algorithms will be developed by the Government and furnished to the contractor. Data collected using the FAA Doppler weather test bed radar will provide the primary basis for algorithm development. This radar, previously used at Memphis, Huntsville and Denver, is now operating

gained in the development, design, production, installation and implementation of next generation weather radar (NEXRAD), Terminal NEXRAD, and associated studies. NEXRAD experience will be particularly significant in developing the TDWR algorithms and specification.

Products: 47 Terminal Doppler Weather Radar Systems (including 1 support system at the FAA Technical Center and 1 support system at the FAA Aeronautical Center).

Related Projects/Activities: AAS, NEXRAD, RMMS, and Spectrum Engineering are related projects. 17 NEXRAD units will be configured for terminal operation to provide early operational capability and experience with Doppler weather radar in the terminal area. After TDWRs are implemented, 13 of the NEXRAD units will be redeployed to NEXRAD locations with the remainder to be deployed as terminal NEXRADS.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ENHANCED ALGORITHM
INITIAL ALGORITHM
OPS EVALUATION
OPS EVALUATION
F&E
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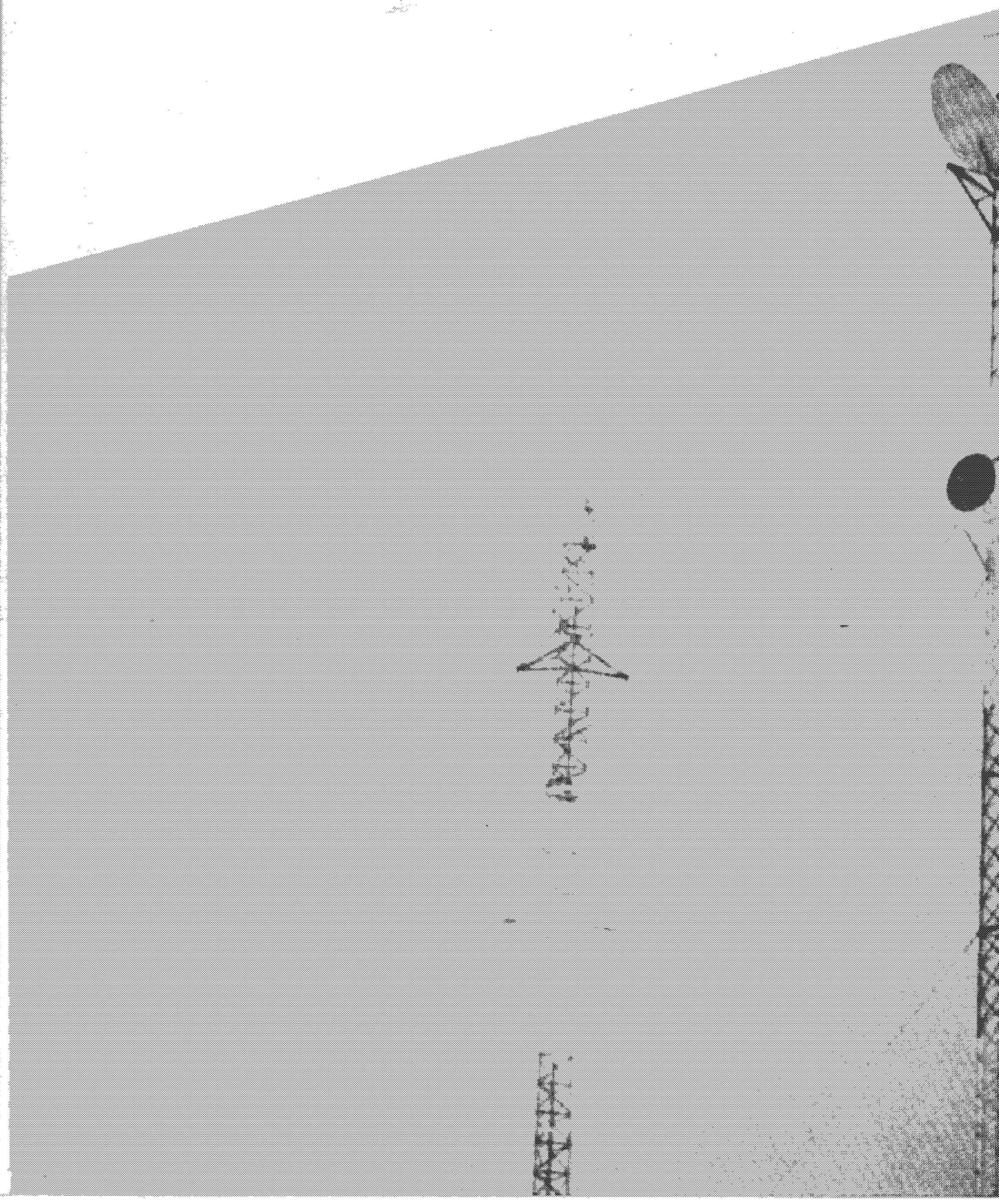
CONTRACT AWARD
STUDY COMPLETE
DESIGN AND PRODUCTION
TDWR CONTRACT AWARD
IMPLEMENTATION

CHAPTER V

INTERFACILITY COMMUNICATIONS SYSTEMS



INTERFACILITY COMMUNICATIONS SYSTEMS

Interfacility communications systems provide communications between FAA facilities, including major manned facilities, such as air route traffic control centers, airport traffic control towers, and smaller remote facilities, such as radar sites and ground-to-air radio sites.

Although most interfacility services used for both voice and data transmission are currently leased, some are FAA-owned. Most FAA-owned transmission media are radar microwave link (RML) equipment. RMLs are used to send en route radar information to appropriate air route traffic control centers. These links also are used for backup emergency communications (BUEC), ground-to-air receivers and transmitters, and other limited applications. These RMLs span about 16,000 miles.

The FAA also owns television microwave links (TML) which are used to transmit remote radar information to tower BRITE displays at satellite airports. They also can be used to transmit remote data across an airport where it is too expensive to lay cable.

Most transmission media are leased, generally from local utility companies. Low-speed teletypewriter networks emanate from the Kansas City, Missouri, National Communications Center (NATCOM). These networks distribute a variety of aviation-related national and international information. Functions performed by these networks include distribution of flight plan information (Service B), weather information (Services A and C), and international messages (aeronautical fixed telecommunications network (AFTN)). Multiple terminals are collocated in the same facility. Network interconnections also are provided to other countries, the National Weather Service, and other users, such as airlines.

Most data circuits are low-speed (150 bits-per- second or less) subvoice-grade lines. Little inter- operability exists on these circuits. Medium-speed lines (2400 bits-per-second) are used to connect newer equipment, such as computers. Very few high-speed circuits exist.

Voice circuits generally are leased, private lines between major facilities or between major facilities and remote facilities. In addition to voice applications, they are used for monitoring and control of transmitters, receivers, and navigational aids.

THE NEW APPROACH

The current interfacility system has evolved piece by piece as requirements dictated. Circuit costs were low, and the ability to provide services was generally limited to public utility communications companies. Over the years, however, common carrier telecommunications rates have escalated and are expected to continue to do so. Recently, competition has emerged in almost all telecommunications areas. Opportunities are now available for the FAA to take a systems approach to its interfacility communication needs and to develop a network which will provide greater reliability through alternate routing capabilities, flexibility, and growth potential, while constraining operating costs.

The NAS interfacility communications system (NICS) will be established to combine and integrate communications functions into one network. NICS will provide voice and data communications interconnectivity between facilities and sites within the NAS, and access to other systems which are external to the NAS (e.g., automatic voice switching network (AUTOVON)). NICS will support other NAS elements by providing voice and data services in three functional areas: (1) transmission, (2) switching, and (3) monitor and control. This new approach will result in better and expanded service to air traffic and other users while controlling cost.

The basic approach is to establish a versatile communications utility which can provide the necessary variety of voice and data transmission and switching systems for all other systems in this Plan. Because communications are essential to the operation of these systems, this utility must evolve and become operational before the systems it serves. Services required include pure transmission of both voice and data (between major facilities and remote facilities) and voice and data switching services primarily between major facilities. Transmission services include the necessary patching and switching to permit service restoral in the event of partial system failures. This system will evolve in a way which permits it to satisfy our current and near-term requirements as well as the long-range requirements of the late 1990s. A number of projects have been defined which, when individually completed and integrated, will result in the NAS interfacility communications system. These projects are described in this chapter and in chapter III.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Activities already completed have upgraded system performance with emphasis on containing costs and providing a step toward the NAS interfacility communications system. These activities provided for the development of a firm foundation for subsequent network establishment.

A cost-savings project was initiated in 1981 to replace all teletypewriter-grade lines and teletypewriter equipment in Alaska where maintenance and leased-line costs are most severe. Outdated equipment has been replaced with higher speed, multiplexed services and state-of-the-art terminals. This service is fully leased. It has increased leased services costs by $400,000 per year, but it has led to the abolishment of 30 maintenance positions. Also, it has eliminated the need to buy expensive replacement parts for the 25-year-old, low-reliability teletypewriter equipment.

The system was expanded into the lower 48 states in 1982 and was expanded again in 1984 and 1985 through the teletypewriter replacement project.

Since the initial FAA computer modems were installed, methods of data transmission have improved significantly. FAA lowered costs by procuring high-speed multiplexing modems and using higher-speed circuits to replace multiple medium-speed circuits. Further economies are possible and efforts will continue in this area.

FAA-owned RMLs, used for special purpose communications, had appreciable spare capacity. By adding the required equipment, it was possible to use these links as trunks for general-purpose communications. For example, a long leased line can be replaced by a channel within an RML system and two local circuits. FAA has implemented this highly cost-effective method as the backbone of an FAA transmission network.

The FAA has begun to establish a National Airspace Data Interchange Network (NADIN). NADIN will form the nucleus of an FAA switched data network. NADIN will provide greater capability to switch messages throughout the network and replace multiple, low-speed lines and switches with concentrators, switches, and high-speed lines. In addition to improving flexibility, NADIN will save several million dollars annually in leased-line costs. The NADIN buildings are sized to allow the eventual replacement of the NATCOM computers, reducing leased services costs and facility overhead.

A number of management-related actions are underway to improve interfacility communications services at lower costs. The FAA is examining its total management information system needs and will create an information system which will provide better cost tracking, accountability, and flexibility in ordering leased service. A systems support contractor has evaluated all interfacility communication needs and has defined basic system interconnections and equipment needed.

NEAR TERM (TO 1990)

There will be significant changes as the FAA communications system evolves into a comprehensive integrated network. A key element of this evolution is the network design. The network design accommodates NADIN expansion, RML expansion, and network management.

The NADIN system will evolve into a general purpose, data transmission system with alternate routing capabilities to bypass failed or saturated areas. It will be the nucleus of the FAA switched data telecommunications system.

Multiplexing will continue and allow facilities requiring access to the communications network to do so in a cost-effective manner. It will eliminate a large percentage of dedicated or individual lines. Multiplexed circuits will be used to connect multiple remote points to the network's backbone.

Many multiplexed tails or spur lines will terminate at such facilities as airport traffic control towers where multiple, low-speed systems (for items such as weather observation, surveillance, etc.) will exist.

During the near term, transmission media will likely be a mix of satellites, leased circuits, and radio links. Current analysis indicates that it is cost-effective to upgrade and expand the FAA's RMLs to radio communications links (RCL) for general interfacility use. As shown on the maps, RMLs will be converted to RCLs in a configuration suitable for many backbone and tail circuit uses. Cost performance of satellite transmission, however, is improving; and for long-distance, high-density communications, satellites will probably be more cost-effective. Satellites may also be used to back up the FAA transmission system in the event of catastrophic failure or extended outages of a primary communications node. Thus, toward the end of the period, some new mix of satellite, FAA-owned, and leased transmission is likely.

The airport telecommunications program to replace deteriorating and unreliable cables, around low- and medium-activity airports, with new technology distribution systems such as fiber optics and RF data links will begin.

By 1990 new voice communications switching equipment installation will have been completed in many facilities. This will limit leased equipment costs, provide better operational features, and allow greater flexibility in reconfiguring positions during off-peak traffic periods. ICSS will be used in automated flight service stations, ATCTs, and TRACONs.

By accomplishing the above, a comprehensive communications network will be established. It will encompass satellite links, RML backbone, tail circuits, local area networks, and switching and control equipment. The network will be designed so that facility consolidation and activities requiring cost-effective communications can be supported.

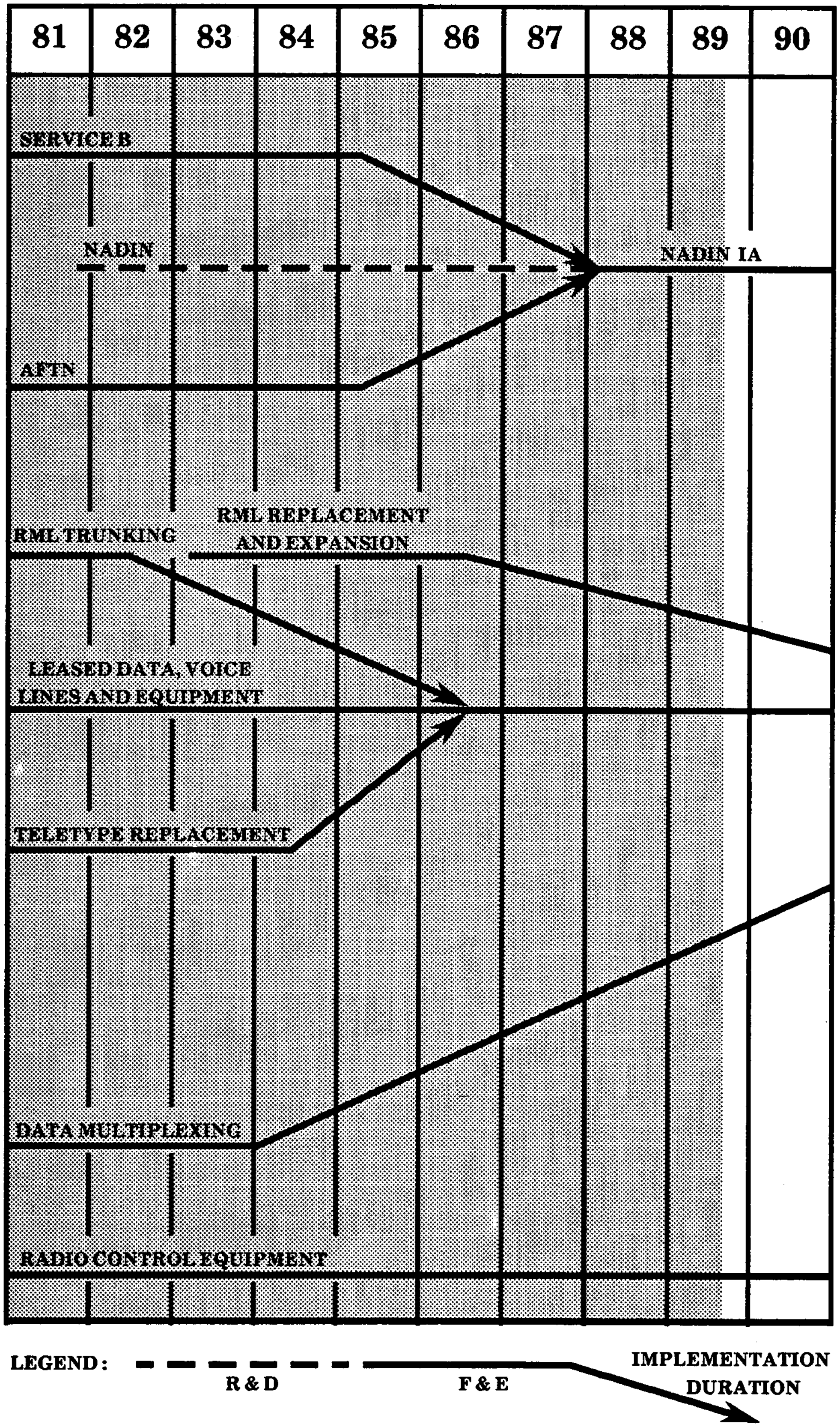
LONG TERM (TO 2000)

In the long term, facility consolidation (AFSSs and ACFs) and new services such as Mode S data link and automated en route air traffic control (AERA) impose increasing interfacility requirements. The comprehensive network will accommodate these requirements. The appropriate technologies (including satellites) will be used. VSCS and a new tower communications system (TCS) will be provided. Additionally, new solid-state radio control equipment (RCE) will be used to improve system reliability and reduce maintenance and logistics costs.

Network control and monitoring will be automated at one or more centralized locations. This will maintain the global system configuration at optimum capacity and efficiency and reduce system restoral times.

The NADIN data network will be expanded to provide switching capability and network monitoring to meet FAA requirements.

The following diagram and maps describe the evolution of the system.



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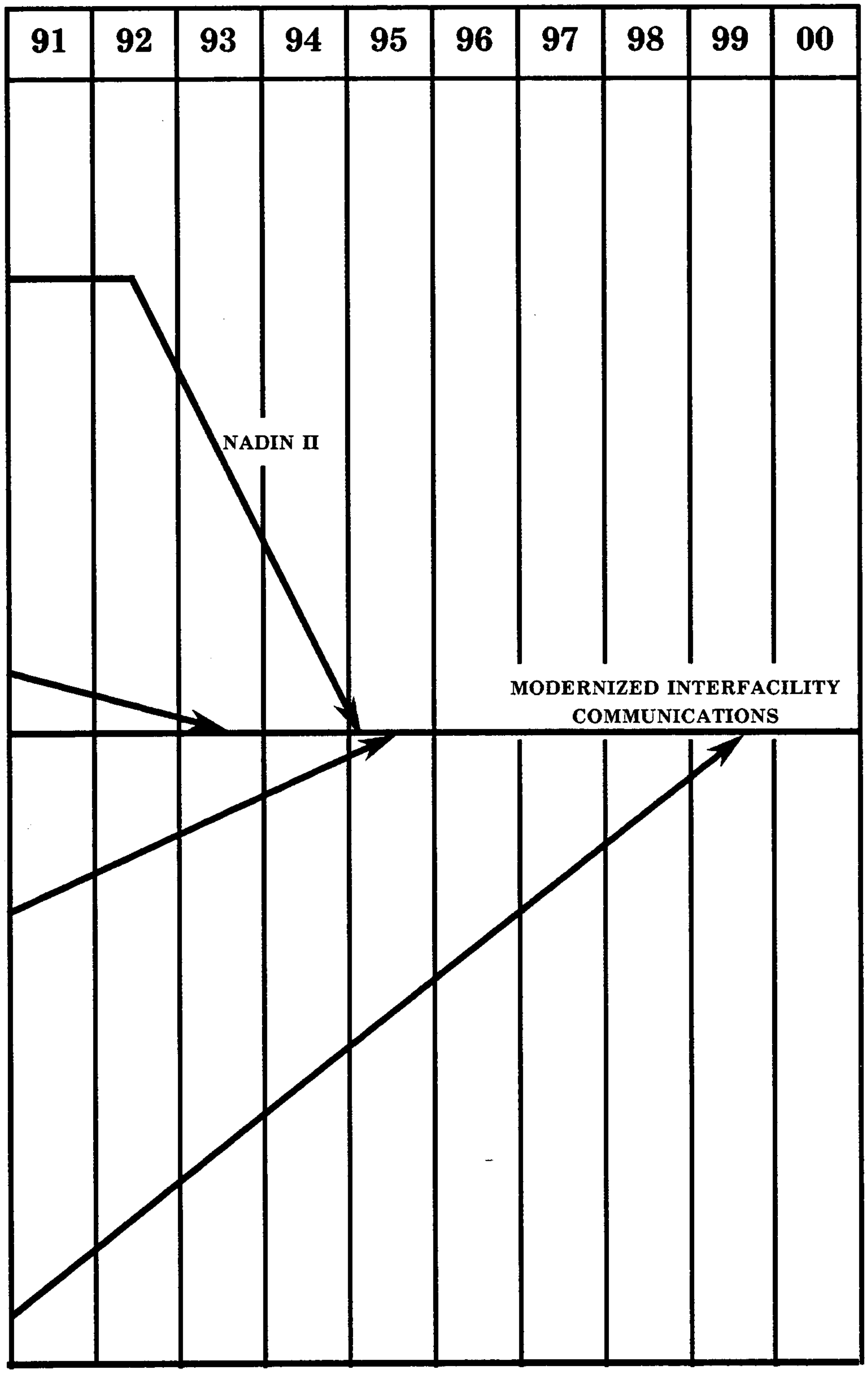
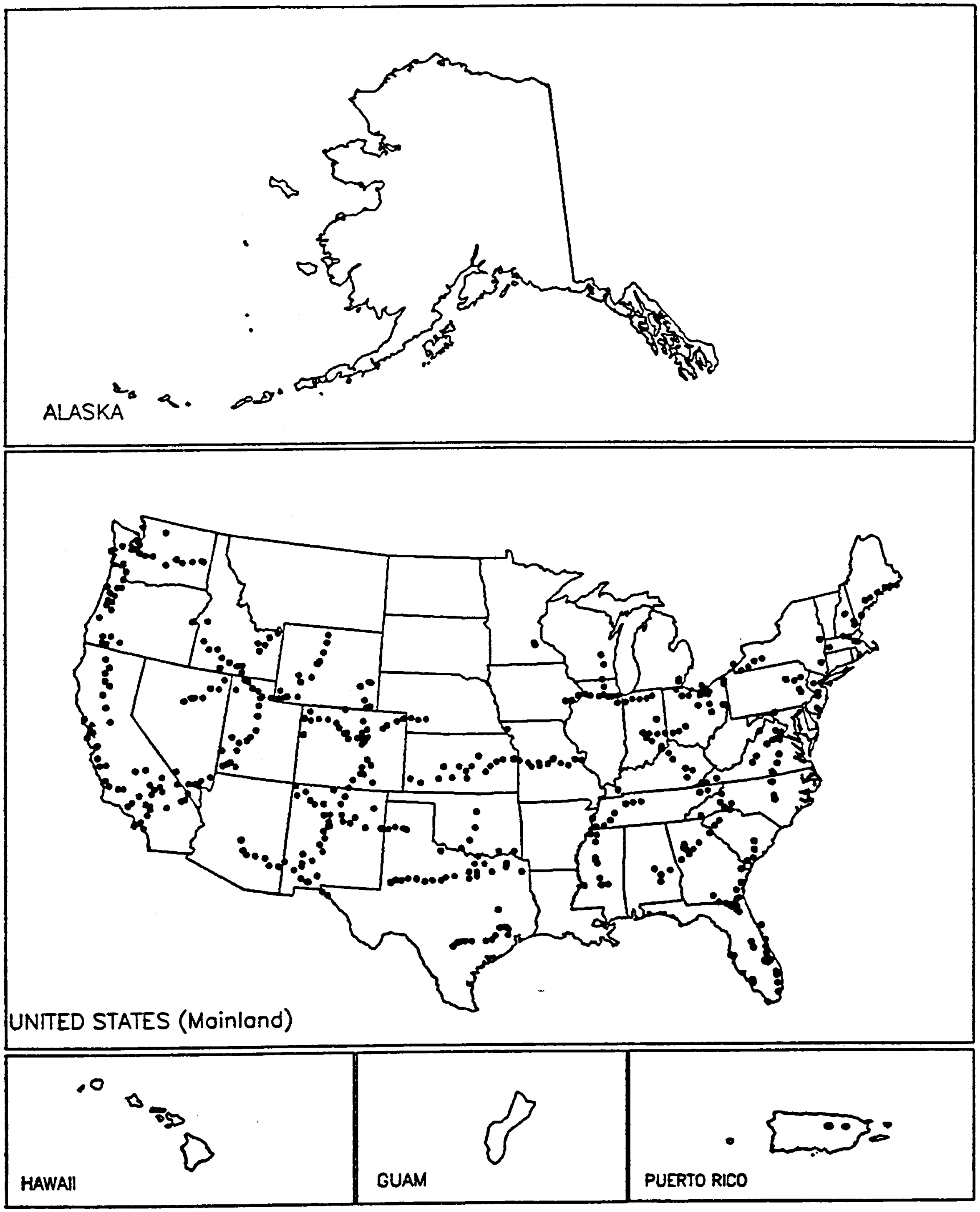
SERVICE B
NADIN
NADIN IA
AFTN
RML TRUNKING
RML REPLACEMENT AND EXPANSION
LEASED DATA, VOICE LINES AND EQUIPMENT
TELETYPE REPLACEMENT
DATA MULTIPLEXING
RADIO CONTROL EQUIPMENT
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



INTERFACILITY COMMUNICATIONS SYSTEMS
EVOLUTION

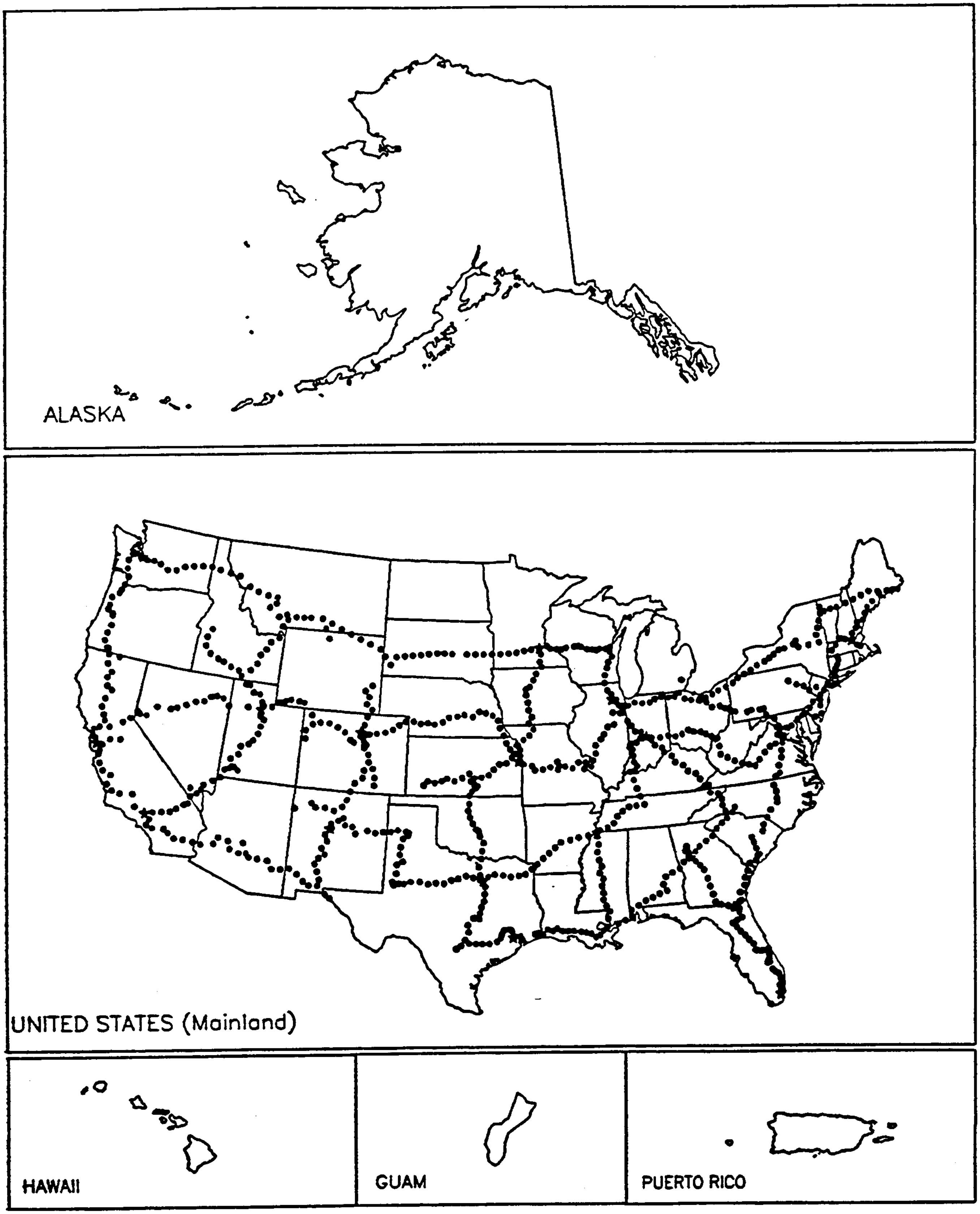
THIS MAP DEPICTS THE RADAR MICROWAVE LINK (RML) SYSTEM. THE RML PROVIDES A MEDIUM TO TRANSFER RADAR BROADBAND AND NARROWBAND DATA TO THE ARTCCs FROM REMOTE RADAR SITES. DATA MULTIPLEXING EQUIPMENT WAS RECENTLY ADDED TO REDUCE LEASED-LINE COSTS. BY 1990, THE SYSTEM WILL FORM THE INITIAL "BACKBONE" RCL VOICE AND DATA TRANSMISSION SYSTEM TO FURTHER REDUCE LEASED COMMUNICATIONS COSTS AND IMPROVE RELIABILITY.



1981 - 1985 SYSTEM
RADAR MICROWAVE LINK

BY THE END OF 1990, MOST OF THE FAA'S MICROWAVE LINK NETWORK WILL BE IN PLACE AND UPGRADED TO RADIO COMMUNICATIONS LINKS (RCL). THE SYSTEM WILL FUNCTION AS A GENERAL TRANSMISSION TRUNKING NETWORK AND WILL FORM THE BACKBONE TRANSMISSION MEDIA FOR THE NAS INTERFACILITY COMMUNICATIONS SYSTEM (NICS). PATHS TO BE UPGRADED AND NEW PATHS TO BE ADDED WILL BE SELECTED ON THE BASIS OF TOTAL NETWORK CONNECTIVITY REQUIREMENTS AND AVAILABILITY OF ALTERNATE MEDIA WHERE COST-BENEFICIAL. THE CHART SHOWS TENTATIVE ALIGNMENT OF THE RCLs. THE ACTUAL ALIGNMENTS ARE SUBJECT TO ONGOING ENGINEERING ANALYSIS.

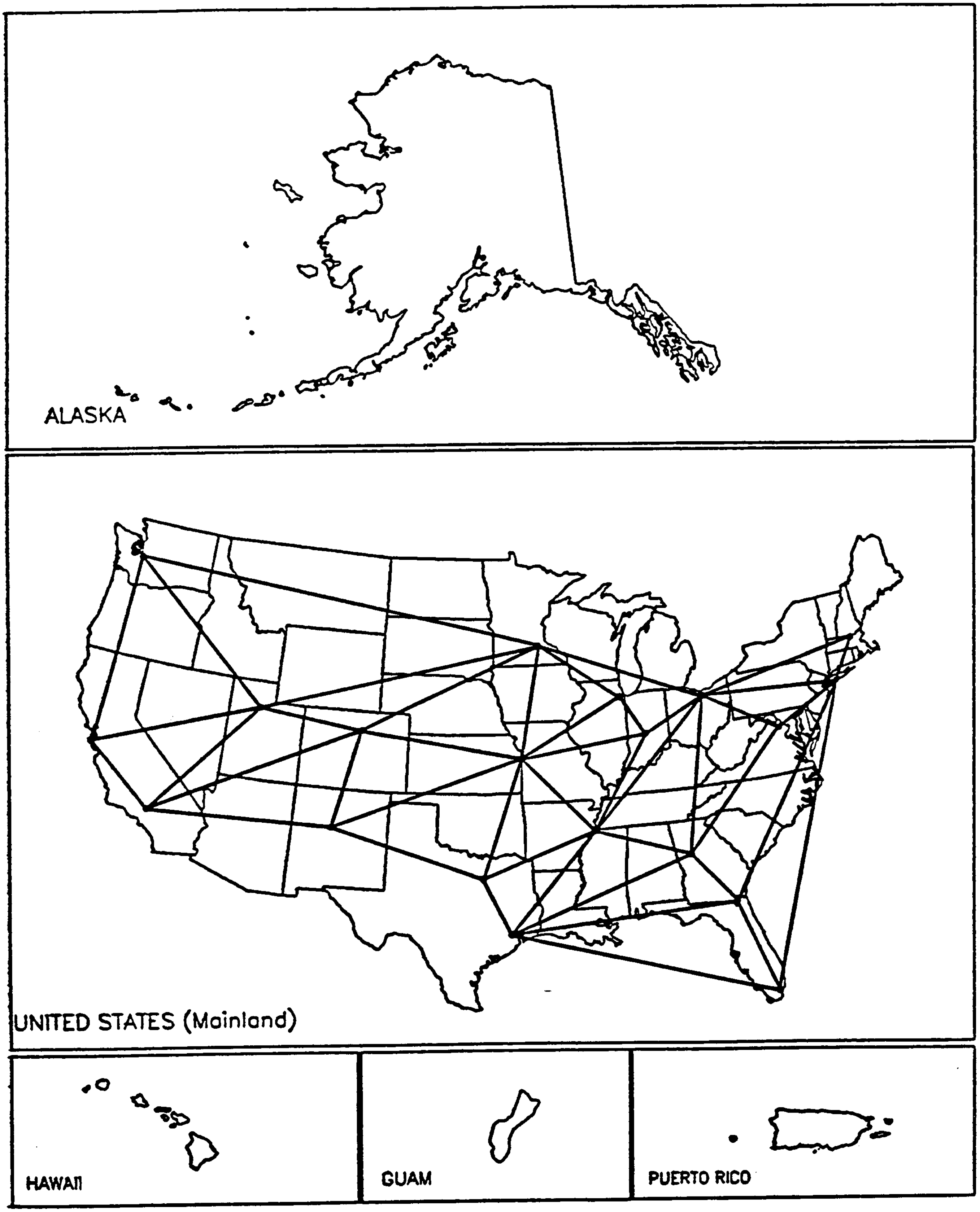
THROUGH THE YEAR 2000, FAA MICROWAVE LINKS WILL CONTINUE TO BE USED FOR TRUNK TRANSMISSION OF VOICE AND DATA BETWEEN MAJOR FACILITIES AND FROM REMOTE FACILITIES TO MAJOR FACILITIES.



1990 - 2000 SYSTEM
RADIO COMMUNICATIONS LINKS

THE ARTCC COMPUTER INTERFACILITY DATA LINES ARE DEPICTED ON THIS MAP. NOTE THAT THESE ARE POINT-TO-POINT LINES WITH NO THROUGH CONNECTIVITY (I.E., OAKLAND CANNOT COMMUNICATE DIRECTLY TO DENVER). ARTCCs ARE ALSO CONNECTED TO MANY ARTS FACILITIES. FDIO/FDEP LINES TO ATCTs ARE NOT SHOWN FOR CLARITY.

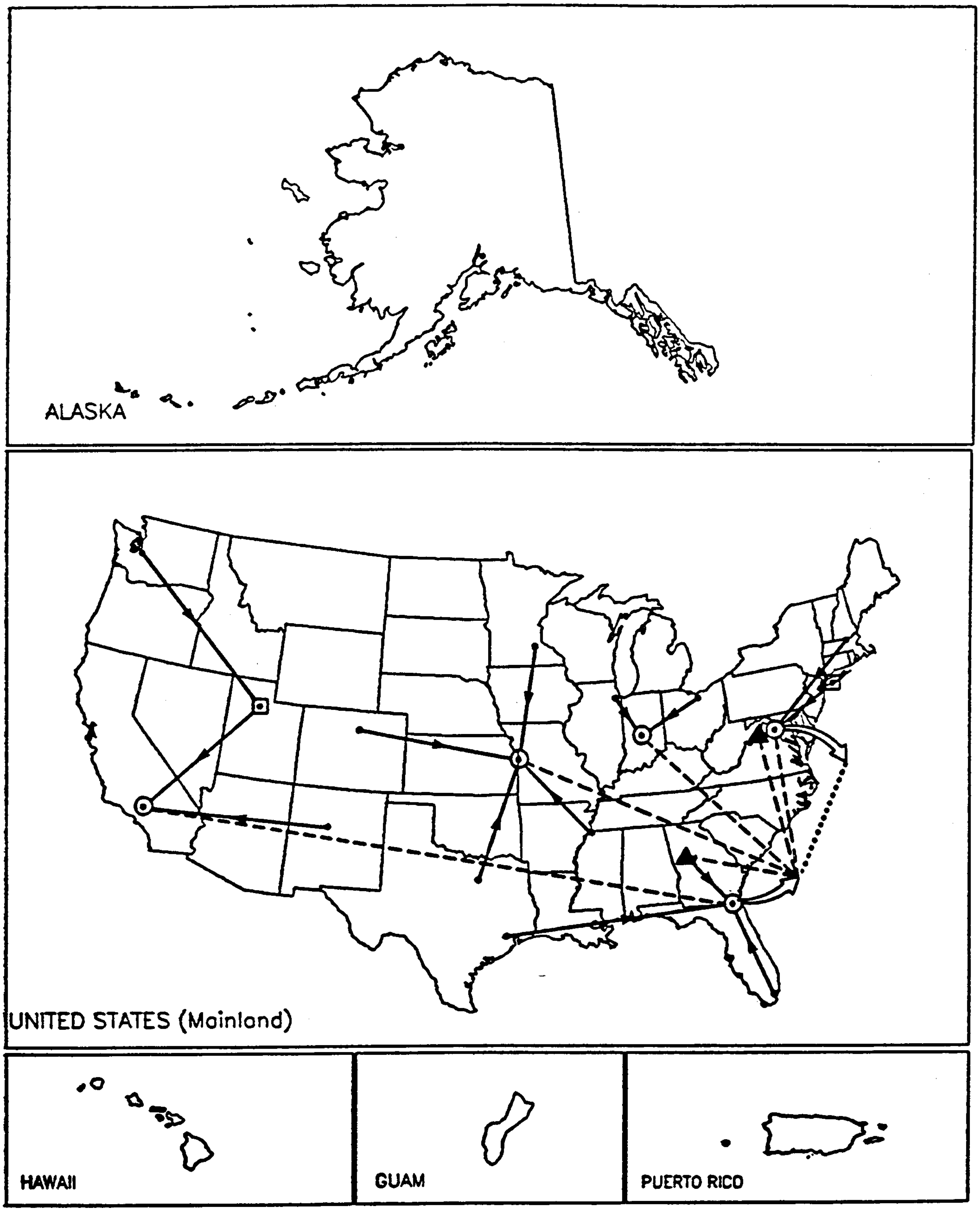
BY 1990, THE NADIN SWITCHING SYSTEM AND THE RCL BACKBONE TRANSMISSION SYSTEM WILL SIGNIFICANTLY IMPROVE THE COST-EFFECTIVENESS OF THIS SYSTEM.



1981 - 1985 SYSTEM
NAS/NAS INTERFACILITY

THIS MAP DEPICTS THE PREVIOUS CENTRAL FLOW CONTROL COMMUNICATIONS. DATA CIRCUITS CONSISTED OF 2,400 BPS LINES FROM FIVE STORE-AND-FORWARD ARTCCs TO THE JACKSONVILLE CENTRAL FLOW CONTROL COMPUTER. IN 1984, THE TRAFFIC MANAGEMENT SYSTEM WAS ESTABLISHED AND BEGAN CONVERTING TO NEW COMPUTER FACILITIES AT ATLANTIC CITY, NEW JERSEY, WITH OPERATIONS IN FAA HEADQUARTERS.

- ▲ ARTCC EMERGENCY OPERATING FACILITIES
- ● ARTCC (NODE)
- ⊡ ARTCC (RELAY CENTER)
- ◉ ARTCC (STORE-AND-FORWARD CENTER)
- — — — NEW DEDICATED 2,400 BPS DATA CHANNELS
- •••••• NEW MULTI-4800 BPS DATA CHANNELS

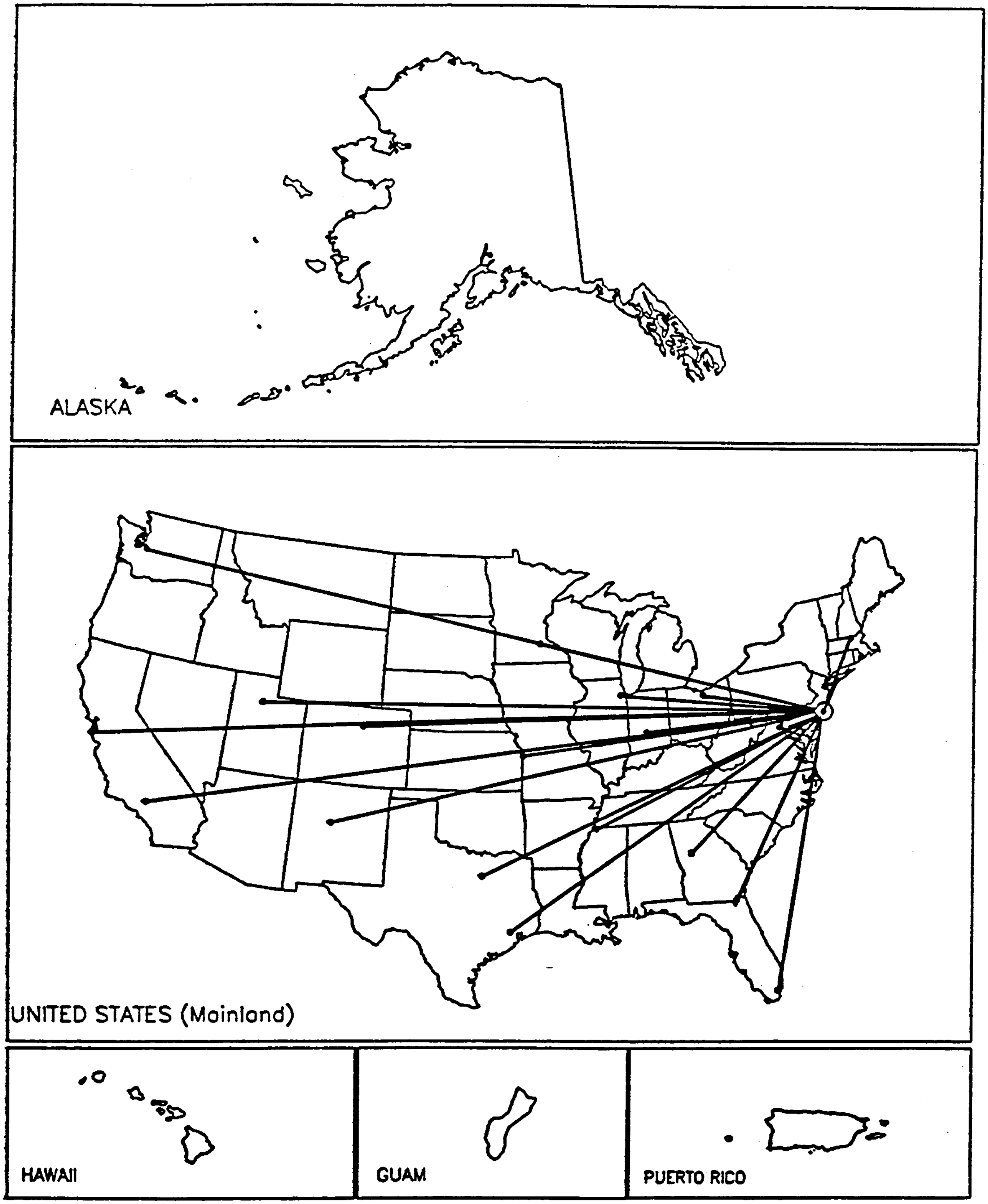


1981 SYSTEM
CENTRAL FLOW CONTROL COMMUNICATIONS SYSTEM

THIS MAP DEPICTS THE MAJOR FACILITIES WHICH MUST BE PROVIDED COMMUNICATIONS FOR TMS OPERATIONS. TMS DATA CHANNELS FROM THE ARTCCs/ACFs TO THE TMS COMPUTER ARE PROVIDED BY THE DATA MULTIPLEXING PROJECT AND SHARE THE USE OF VOICE GRADE CIRCUITS WITH DATA CHANNELS FROM OTHER PROJECTS.

● TMS COMPUTER COMPLEX

■ ATCCC, WASHINGTON, D.C.

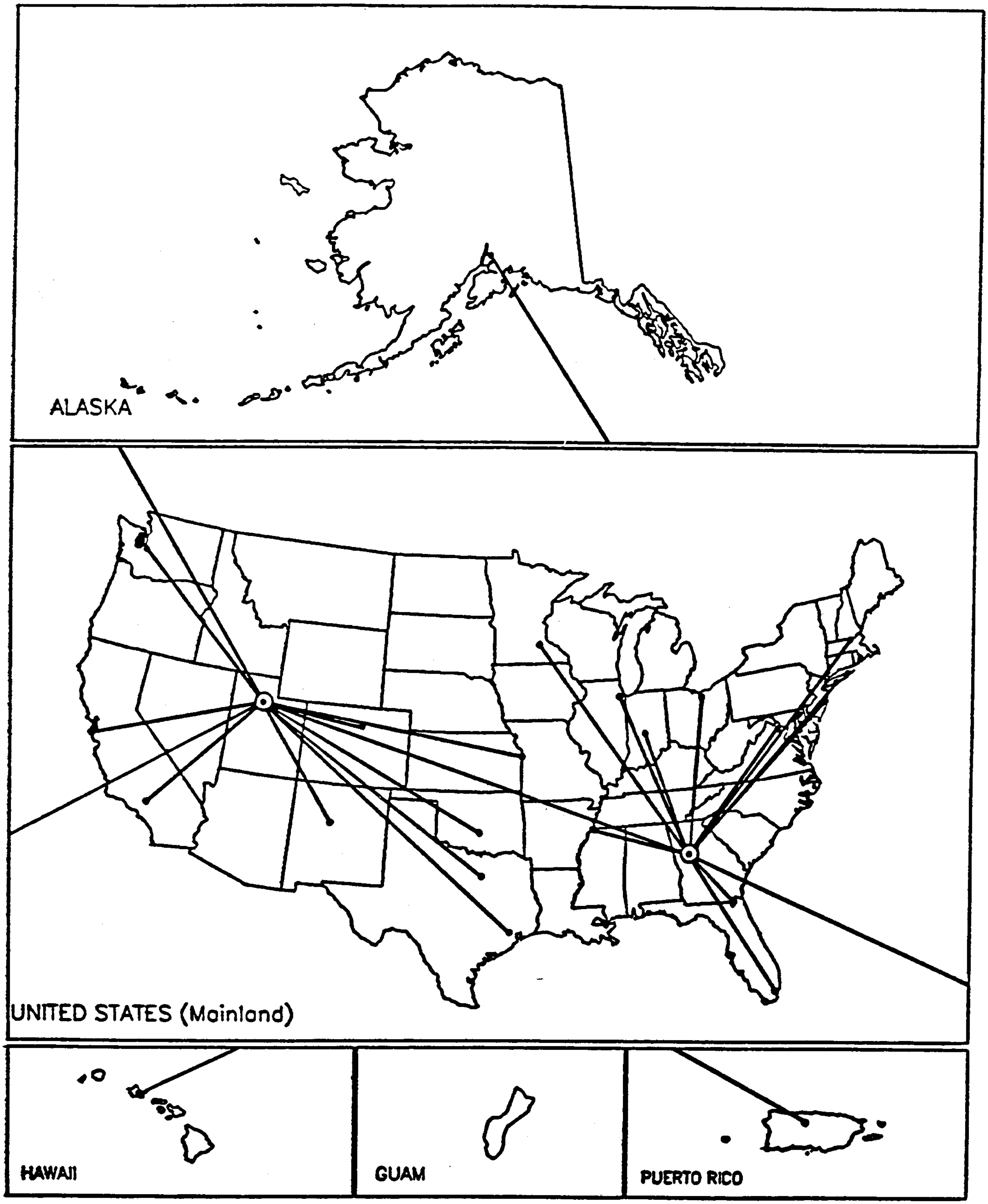


1985 - 2000 SYSTEM
TRAFFIC MANAGEMENT SYSTEM COMMUNICATIONS

IN 1988, THE NADIN DUAL STAR CONFIGURATION REPLACED THE AFTN, SERVICE A, AND SERVICE B MULTIPLE LOW-SPEED SERVICES. MESSAGE SWITCHES ARE LOCATED AT SALT LAKE CITY AND ATLANTA AND CONCENTRATORS ARE LOCATED IN EACH ARTCC. TOTAL CIRCUITS FROM CONCENTRATORS TO OTHER FACILITIES ARE NOT SHOWN FOR CLARITY.

○ LOCATION OF NADIN MESSAGE SWITCHES

● LOCATION OF CONCENTRATORS



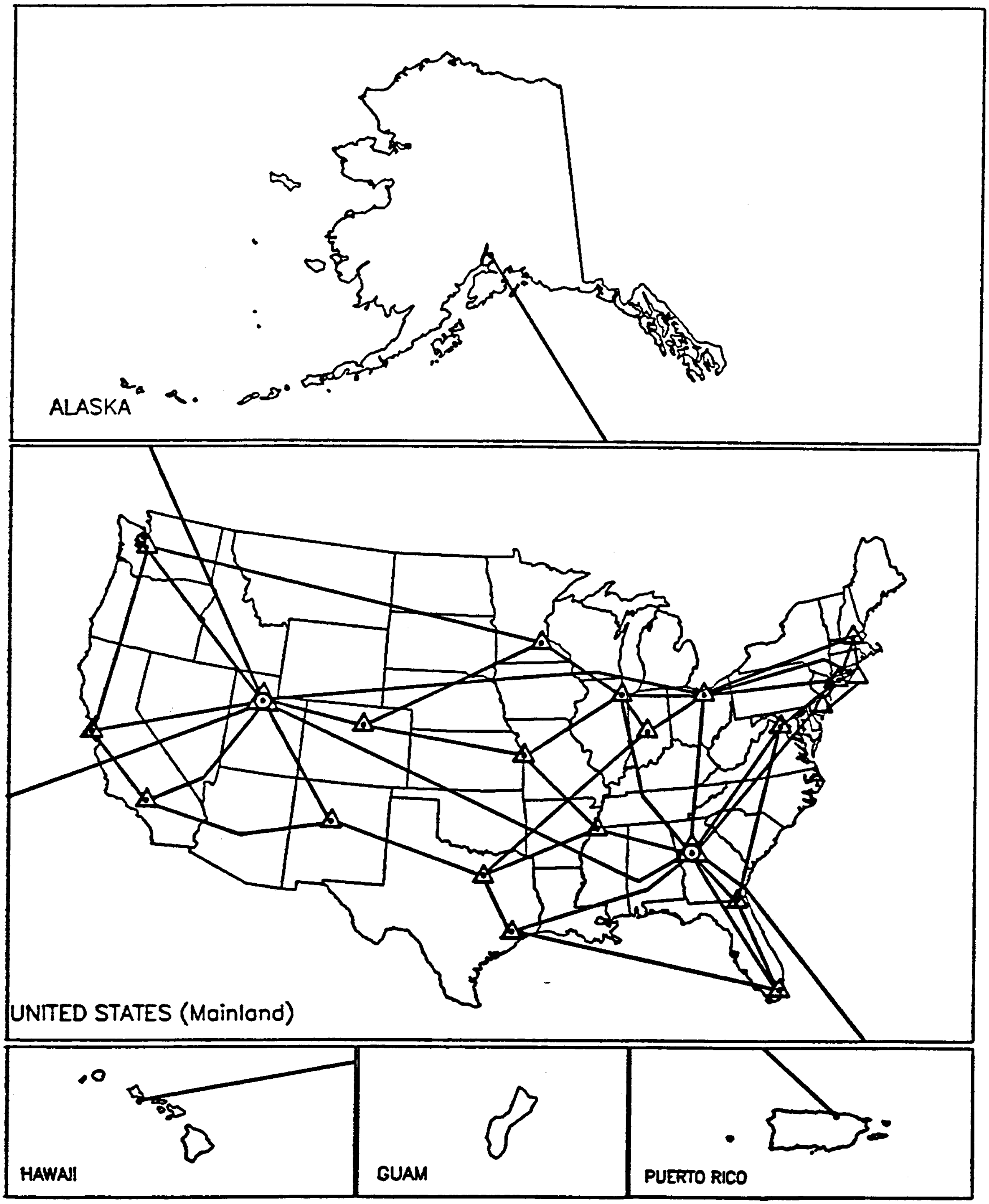
1988 SYSTEM
NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN IA)

THIS MAP SHOWS TYPICAL ENHANCED NADIN CONNECTIVITY WHEN NADIN EVOLVES FROM A DUAL STAR CONFIGURATION TO A MESSAGE AND PACKET SWITCH NETWORK WITH ALTERNATE ROUTING CAPABILITY. ALTERNATE ROUTING ALLOWS DATA TO BYPASS FAILED OR SATURATED CIRCUITS. NADIN PROTOCOL DESIGN WILL BE MEDIA INDEPENDENT AND ALLOW ANY COST-EFFECTIVE TRANSMISSION MEDIA MIX TO BE USED. BY THIS TIME, IT IS EXPECTED THAT NADIN, TOGETHER WITH ITS MULTIPLE TAIL CIRCUITS, WILL HAVE ABSORBED ALMOST ALL INDEPENDENT FAA DATA CIRCUITS. ACTUAL CONNECTIVITY IS SUBJECT TO ANALYSIS. TRANSMISSION FACILITIES WILL BE PROVIDED BY THE RCL "BACKBONE" NETWORK.

○ LOCATION OF NADIN MESSAGE SWITCHES

● LOCATION OF CONCENTRATORS

△ LOCATION OF PACKET SWITCHES



1992 SYSTEM
NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN)

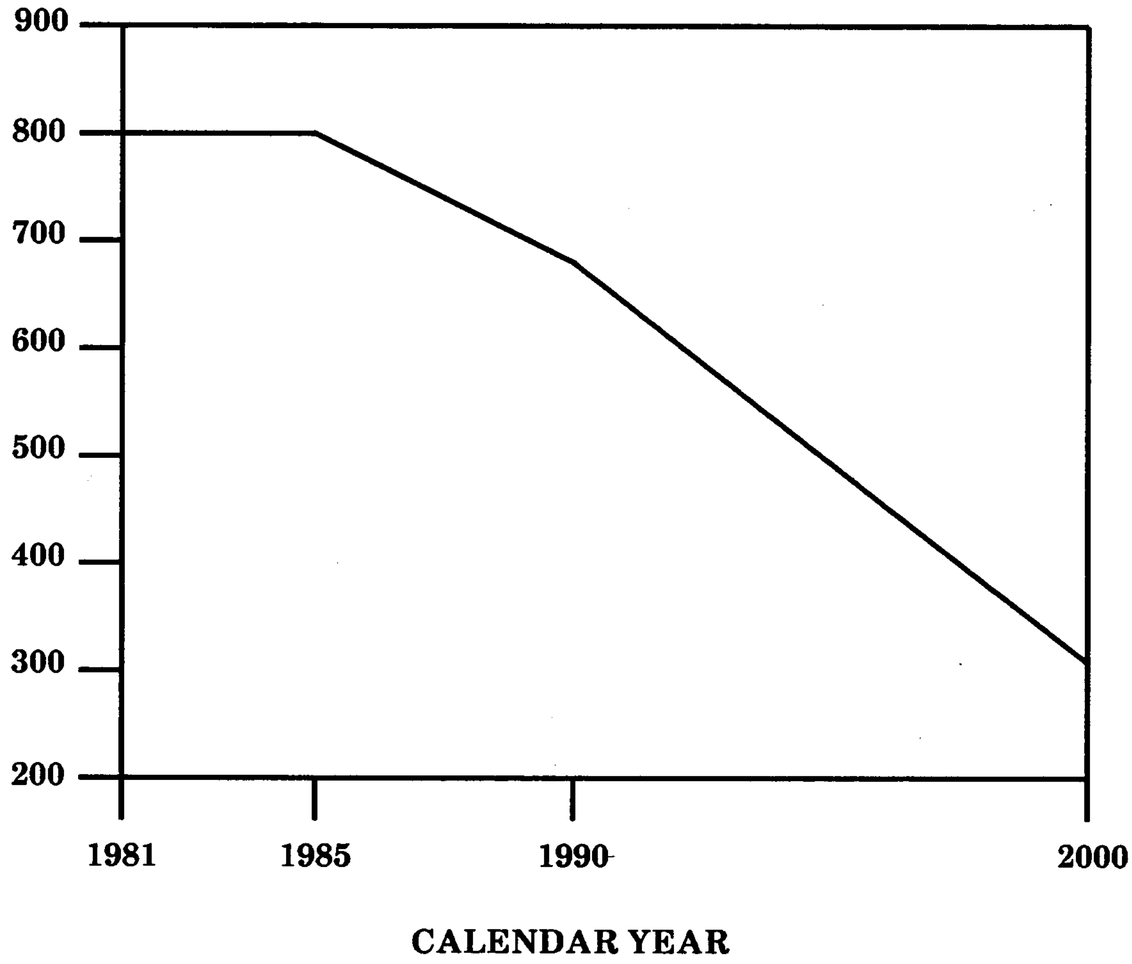
RETURN ON THE INVESTMENT

As a result of these planned actions, overall agency operating costs will be significantly reduced. The introduction of new technology will allow for a decrease in maintenance staffing despite the expansion of FAA-owned facilities to reduce reliance on leased systems. Leased service costs will be contained, and a more reliable and flexible data and voice transmission system will be available.

FIELD EMPLOYMENT

Employment levels reflect the Airway Facilities sector management and subordinate positions required to staff the interfacility system. Air Traffic staffing is not required for this system.

During the next 11 years, the interfacility system will undergo changes in hardware, software, and plant improvements. These changes will be reflected within Airway Facilities as shown in the chart below.



AIRWAY FACILITIES EMPLOYMENT
(INTERFACILITY COMMUNICATIONS SYSTEMS)

The changes planned through the year 2000 will decrease current Airway Facilities personnel requirements for maintenance of interfacility systems at field facilities by 61 percent.

SUMMARY OF FACILITY CHANGES

1981 - A total of 799 field airway facilities technicians were required to maintain the interfacility communications systems.

1985 - High-speed data multiplexing has reduced the number of leased circuits needed to provide long-range radar data to en route centers. Improvements to the RML system have reduced maintenance tasks. Integrated communications switching systems (ICSS) are being installed at towers, TRACONs, and the initial automated flight service stations. The telecommunications management system was upgraded. The teletypewriter replacement program has substantially replaced approximately 350 labor-intensive installations with modern leased terminal equipment. Staffing has increased due to additional communications and TML links, maintenance of the NADIN concentrators, and transition to leased teletype replacement systems.

1990 - Additional high-speed data multiplexing will be added, the initial National Airspace Data Interchange Network (NADIN) IA will be implemented, more than half of the vacuum-tube RML equipment will be replaced with solid-state RCLs, various RCL systems will be interconnected to form a national network, and about 40 additional television microwave links will be added to provide radar data to satellite towers. Staffing requirements will be reduced to 682.

2000 - Facility consolidation, continued expansion of NADIN functions and the RCL network, NADIN II will be implemented, and replacement of leased voice switching systems with agency-owned equipment will continue to reduce overall staffing and operating costs.

Outyear estimates are reviewed annually and are subject to revision.

INTERFACILITY COMMUNICATIONS SYSTEMS AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS (1981 Dollars)

	1981	1985	1990	2000
Operations (Millions)	151.5	143.5	146.1	185.1
Airway Facilities Personnel	799	804	682	308
AF Productivity Quotient	189,612	178,483	214,223	600,974
Airway Facilities Personnel Costs (Thousands)	$27,246	$27,416	$23,256	$10,503

PROGRAM RELATIONSHIPS

The NAS interfacility communications system (NICS) forms the connective and transmission network to tie together the many components of the National Airspace System. The NICS plays a major role in assuring that the most efficient and reliable communications switching and transmission modes are used. Virtually all of the new systems require data or voice communications to other facilities and will use the services provided by the NICS. The programs described in this chapter establish a national communications network which will use standardized switching systems and a backbone transmission system of microwave links. The NICS will, however, encompass many of the present and future leased communications services provided by outside vendors when those services are determined to be at least as reliable and more cost-effective than using FAA-owned systems.

As flight service facilities are consolidated into the automated flight service stations (AFSSs) and radar approach control facilities are merged into the area control facilities (ACFs), the need for more and better communications capabilities, along with lower unit costs, becomes very apparent. Voice communications, the predominant mode of the present system, will give way to increasing amounts of digital data communications for virtually all systems. Air route traffic control centers (and later, ACFs) will be digitally interfaced with nearly every type of facility within the bounds of their control areas as well as adjacent en route facilities. AFSSs will require high-speed digital communications with flight service data processing systems (FSDPSs) located at air route traffic control centers (ARTCCs/ ACFs). Tower suites will communicate intensively with the ACFs, passing radar and tracking data, as well as coordination between controllers. Remote weather-collection facilities, radar and air/ground communications sites, navigation and landing facility remote monitoring systems, and national networks for traffic management and weather information will all add to the present data switching and transmission requirements as the NAS is implemented. The projects presented in this chapter are designed to not only accommodate this growth in data, but to do so with reduced operations costs.

The projects are grouped into three general categories: those which improve the transmission subsystem that carries voice and data between facilities, the switching subsystem which provides the proper connectivity between users, and one project, now completed, which replaced the obsolete teletypewriter equipment.

TRANSMISSION

The radar microwave link (RML) trunking project, which is now completed, utilizes excess signal-carrying capacity of the current RMLs to transmit between ARTCCs. Multiplexing modems provide the capability to mix data from many sources on a single voice channel and separate it at the receiving end. Many multiplexing modems are already in place and are proving to be highly cost-beneficial. The obsolete and maintenance-intensive radar microwave links will be replaced with modern, reliable radio communications links (RCL). Some expansion of the existing network is necessary to provide a national backbone of interconnected links which will have the capacity to handle virtually all of the ACF-to-ACF data/voice communications as well as much of the tower, flight service, weather collection and dissemination, and remote maintenance monitoring data. Completing the transmission subsystem are two projects which will benefit the terminal facilities--the TML project (now combined with BRITE) which provides the path for television-formatted radar displays at satellite towers, and the airport telecommunications project which improves the control and monitoring capabilities at small and medium airports.

SWITCHING

The National Airspace Data Interchange Network (NADIN) provides the connectivity required to route vast quantities of data from many sources to the intended recipients. NADIN is being implemented in two parts: NADIN IA, completed in 1988, is a message switched network (MSN) designed primarily to replace two functions now provided by NATCOM, largely on leased lines. NADIN IA will also interface with other data communications users requiring MSN. NADIN II is a packet switched network (PSN) which will be implemented in two phases. Phase I will provide the basic network backbone, nodal switching and network control to provide transfer of large volumes of data at fast response times. Phase II will provide additional system capacity to support the Advanced Automation System (AAS). NADIN will eventually utilize the RCL system for its backbone trunk circuits, reducing significantly the number of leased circuits required. The RCE project replaces the obsolete tone control equipment used to control remote air/ground communications sites with a modern system, incorporating remote maintenance monitoring in its design.

OTHER IMPROVEMENTS

The teletypewriter replacement project, now completed, provided modern interfacility communications terminals to replace the obsolete teletypewriter units in use since the late 1950s.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
TRANSMISSION		
1. RML Trunking	PROJECT COMPLETE	1986
2. Data Multiplexing Networking (DMN)	1983	1995
3. RML Replacement and Expansion	1986	1993
4. Television Microwave Link (TML)	COMBINED	WITH BRITE
5. Airport Telecommunications	PROJECT COMPLETE	1987
SWITCHING		
6. National Airspace Data Interchange Network (NADIN) IA	PROJECT COMPLETE	1988
7. National Airspace Data Interchange Network (NADIN) II	1992	1995
8. Radio Control Equipment (RCE)	1990	1999
OTHER IMPROVEMENTS		
9. Teletypewriter Replacement	PROJECT COMPLETE	1986

PROJECT SUMMARY

PROJECT 2: Data Multiplexing Network (DMN)

Purpose: The Data Multiplexing Network (DMN) provides the NAS with state-of-the-art data communications technologies for cost effective point-to-point data transmission. These technologies include: (1) data multiplexing, which enables a number of independent transmission requirements to be consolidated onto a single circuit; and (2) automated network monitoring and control, which enables the identification of failed network elements from central locations and circuit restoral in real-time. The use of data multiplexing is an integral part of FAA's strategy for cost-effective interfacility communications transmission.

Approach: The DMN project uses commercial off-the-shelf (COTS) equipment and is being accomplished in three phases: Phase I addresses existing en route requirements; Phase II addresses existing terminal requirements; and Phase III addresses network expansion and reconfiguration requirements generated by new NAS Plan projects.

Phase I and II and early Phase III service requirements have been met via a competitively awarded indefinite delivery requirements contract for COTS analog data communications equipment. Future Phase III service requirements will be met via competitively awarded indefinite delivery requirements contracts for COTS analog and digital data communications equipment. Traffic carried by the Phase I and II network includes: long range radar data, en route and terminal interfacility data, Traffic Management Systems (TMS) data, Flight Service Data Processing System (FSDPS) Service A (weather) data, Maintenance Management System (MMS) data, and Computer Based Instruction (CBI) data.

Phase III increases trunk capacity and adds additional terminal facilities and various other locations to the network.

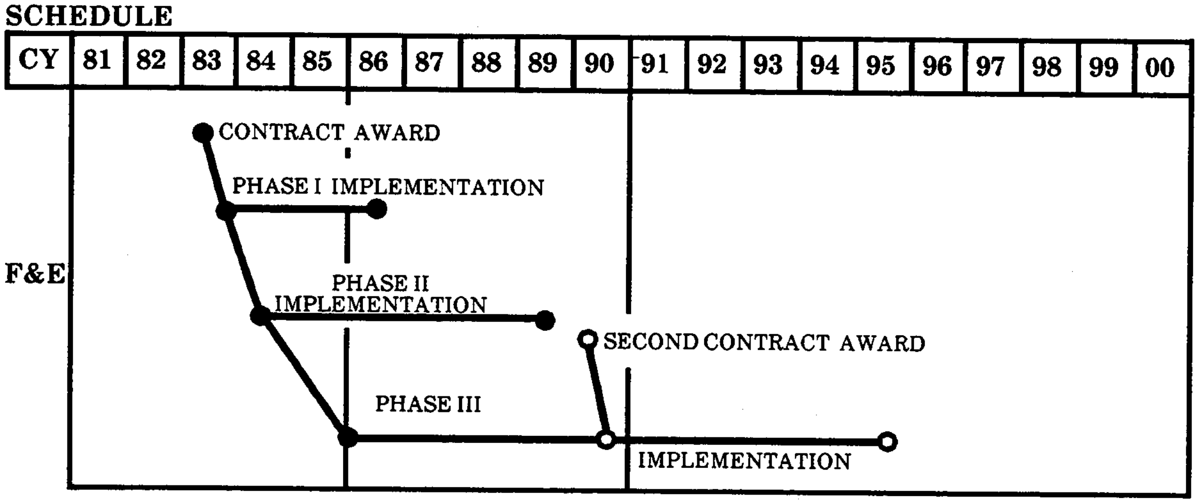
Products:

- Phase I and II equipment delivery and installation were completed in June 1989. They included approximately 3400 major equipment items (modems, multiplexing modems, statistical multiplexers, and automated network monitor and control systems) at over 750 network nodes throughout the continental United States and off-shore locations.

- Major equipment items to be acquired under Phase III include: modems, multiplexing modems, statistical multiplexers, channel service units/data service units, high speed time division multiplexers, automated network management systems, and T1 network facilities.

Related Projects/Activities: The DMN provides network transmission services to a majority of NAS Plan projects that require point-to-point data connectivity.

SCHEDULE



PROJECT 3: RML Replacement and Expansion

Purpose: The FAA Radar Microwave Link (RML) system consists of outdated equipment which is expensive to maintain. This system is required to transmit broadband radar data until late in the 1980s. It must be replaced.

To maximize the cost-effectiveness and availability of the interfacility voice and data transmission needed in the future, an integrated transmission system must be implemented. This system must consider the total traffic, both national and area.

This project contributes to the above objectives by providing modern national microwave radio communications links (RCL) forming a network for voice, data, and radar with capacity for future requirements and redundant and alternate routing capability.

The network will eventually tie together all ACFs and other facilities which have communication needs. The RCLs along with other leased or FAA-owned transmission media will be used to satisfy national communications transmission requirements as well as area network trunking.

This project will ensure the reliable transmission of radar data, reduce the cost for interfacility communications, and improve system availability while providing the flexibility to accommodate the interfacility communications requirements of the NAS Plan.

Approach: An analysis was completed to develop a network design by examining user requirements and FAA objectives with respect to the performance-cost aspects. Transmission alternatives were analyzed, including satellites and leased circuits. Based on this analysis, plans for an overall comprehensive backbone network have been developed which use the existing RML locations as a basis, supplemented by leased circuits, area networks, satellites, and other FAA links where cost-effective.

The RML replacement system will serve as a general transmission medium for FAA voice and data communications. It is highly cost-effective to convert existing special-purpose links used for radar remoting to general-purpose links used for interfacility communications. The existing RML equipment will be upgraded, and additional links will be established to complete a nationwide network. Monitoring of RCL equipment and path integrity will be done with diagnostic and monitoring equipment obtained as part of the RCL network. RCL restoral switching equipment will provide service restoral at the circuit level.

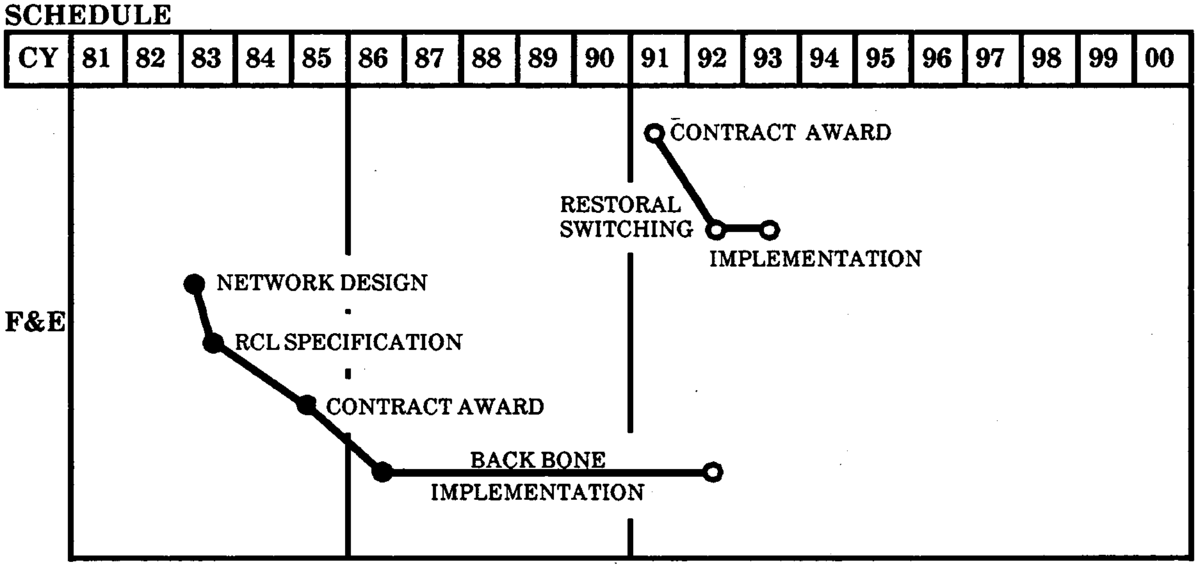
Network Management and Control Equipment (NMCE) will be procured separately to provide network monitoring and to ensure reliable service to ACFs. The NMCE will monitor end-to-end channel integrity. It will provide rerouted service to the primary ACF in case trunks fail and alternate routed service to a backup ACF in case the primary ACF fails. The NMCE will supplement channel monitoring functions with inputs from the Data Multiplexing Analysis System and RCL diagnostic and monitoring equipment.

Products:

- RCL network plan.
- Specifications for RCL.
- Replacement of present 750 RMLs.
- Establishment of some additional 250 backbone RCL facilities.
- RCL restoral switching equipment.

Related Projects/Activities: Data Multiplexing will consolidate data for transmission over the RCL network. NAS Spectrum Engineering support is required to provide interference-free operation. Other NAS Plan programs/projects such as AFSS, RMMS, AAS, ACF, Mode S, and ASR-9, which require data or voice transfer between sites or facilities, will utilize the RCL system as the transmission media.

SCHEDULE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CONTRACT AWARD
RESTORAL SWITCHING
IMPLEMENTATION
NETWORK DESIGN
RCL SPECIFICATION
CONTRACT AWARD
BACK BONE IMPLEMENTATION

PROJECT 5: Airport Telecommunications

Purpose: This project will establish the specifications and criteria for a reliable and flexible signal distribution system for low-activity and medium-activity (Levels I, II, and III) airports. Control, signal, and communication cables at many airports are reaching the point where replacement is necessary for reliable or expanded operation. This program will enable the replacement of deteriorating cables at airports with systems employing new technology, such as fiber optics and RF data link.

Replacement of the cables with new technology will:

- Eliminate outages caused by slowly deteriorating or failing copper cables.
- Reduce leased service costs by use of FAA fiber optic system or RF data link.

Fiber optic installations will:

- Reduce installation costs when installed concurrently with power cable loop systems.
- Eliminate cable damage from lightning surges.
- Reduce interference from noise intrusion.

Replacement of the cables at low-activity and medium-activity airports with RF data links or fiber optics, rather than replacement in-kind, will provide cost-effective, state-of-the-art support for remote maintenance monitoring.

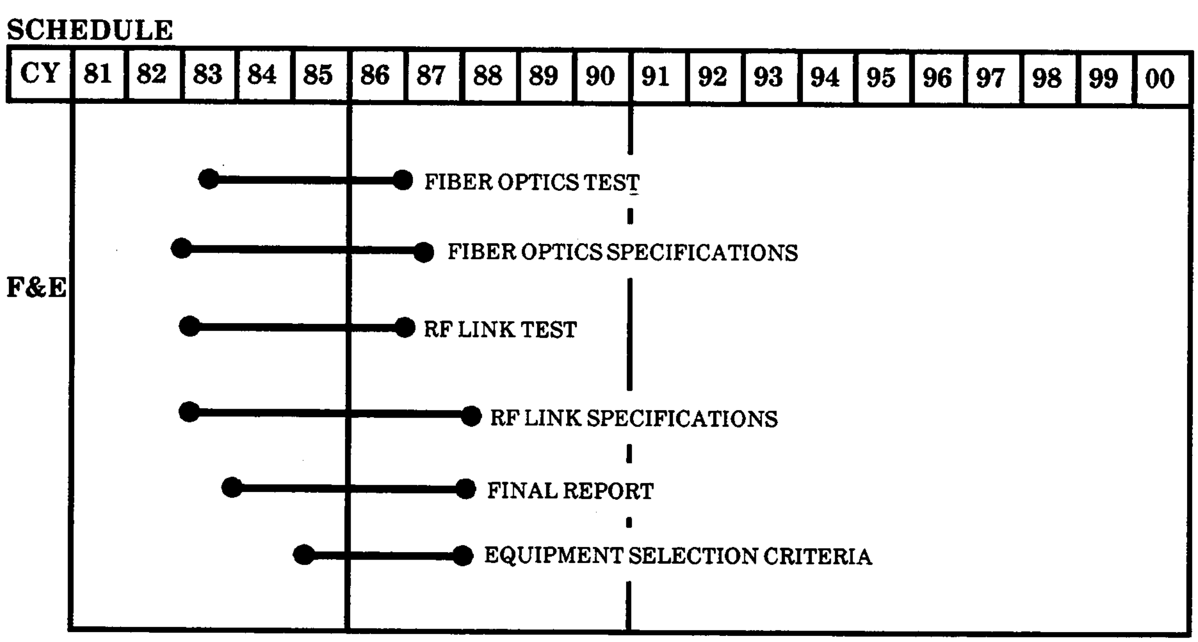
Approach: Planning for cable replacement at the low-activity and medium-activity airports will include an engineering analysis to determine the utilization of fiber optics, RF data link, or other methods. Implementation will be accomplished under Projects 6-05 (Large Airport Cable Loop Systems) and 7-50 (Sustain Telecommunications Support).

Products:

- Test results, specifications and criteria for new technology to replace deteriorating airport cables.

Related Projects/Activities: Airport Telecommunications is related to all airport projects (such as RMMS, MLS, ILS, etc.), which require buried cable for control, signal, or communications between sites. NAS Spectrum Engineering will provide interference-free frequencies for Airport Telecommunications, and will investigate spectrum-efficient communication technologies to satisfy this and other NAS Plan projects requiring RF data links. The emphasis will be on establishing an integrated system to satisfy total RF data link requirements in the airport environment.

PROJECT COMPLETE



PROJECT 7: National Airspace Data Interchange Network (NADIN) II

Purpose: In addition to those requirements served by the NADIN IA message switched network, it is necessary to expand the data switching and throughput to meet the requirements of other major FAA systems and functions in this Plan, (e.g., RMMS, AWP, CWP, WMSC Replacement, AAS, NEXRAD) and the facility (center and terminal) consolidation program.

This project will provide the expanded data switching capability and network management functions required to meet the future FAA communications needs. Increased capacity, flexibility, and service availability will be achieved through the use of packet switching and a highly connected system architecture.

Approach: The system design will be based upon the data flow requirements of new systems and consolidation as the NAS evolves. A highly connected network using packet switch node virtual circuits and automatic alternate routing capability will be implemented. Two centralized network control and monitoring facilities also will be established. Standardization of access interface and exchange protocols will be maintained to ensure future flexibility for system evolution. Message switching will continue to be provided by NADIN IA and will be interconnected with the NADIN II packet switched network. NADIN II hardware and software will be integrated and tested using the support system at the FAA Technical Center.

NADIN II will be implemented in two phases. Phase I will implement packet switching, packet nodes, and added transmission trunking between nodes. Phase II will add capacity and interfaces to the data system.

Products:

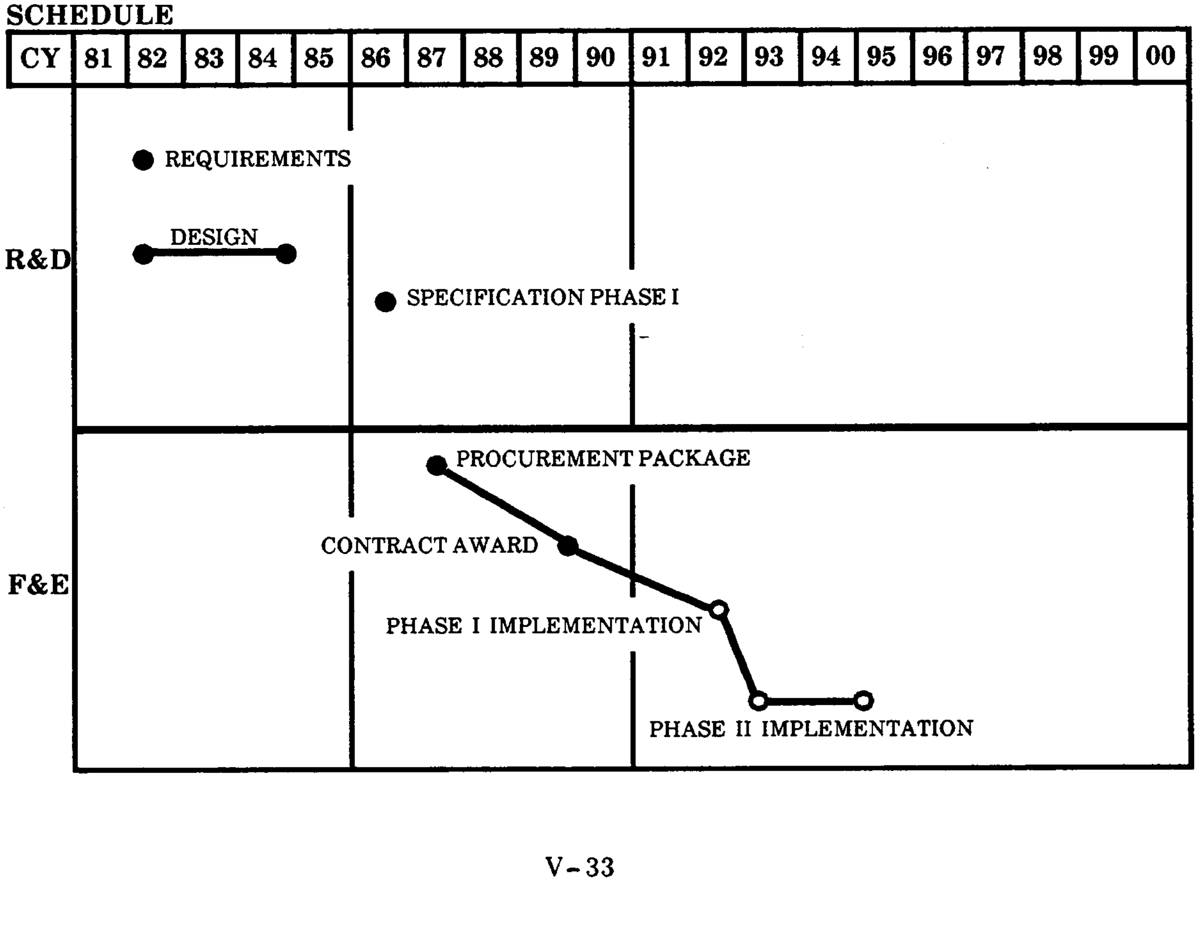
- Approximately 24 operational packet switch nodes will be installed at 20 CONUS ARTCCs, the two National Aviation Weather Processing Facilities (NAWPFs), the New York TRACON, and the FAA Technical Center.

In addition, there will be:

- Two support nodes provided to the FAA Technical Center.
- One support node provided to the FAA Aeronautical Center.
- Two Network Control Centers (NCCs) provided at Atlanta and Salt Lake City NAWPFs for centralized monitoring and control of the NADIN II network.

Related Projects/Activities: NADIN will interface with virtually all NAS operational systems requiring interfacility data switching service. Future needs for area control facilities/advanced automation system will be met by NADIN II. NADIN will be used to switch maintenance management system communications. This project will require interfacility communications service from NICS. Projects providing that service include RML Replacement and Expansion which will provide the transmission network for data flow.

SCHEDULE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REQUIREMENTS
DESIGN
SPECIFICATION PHASE I
F&E
PROCUREMENT PACKAGE
CONTRACT AWARD
PHASE I IMPLEMENTATION
PHASE II IMPLEMENTATION

PROJECT 8: Radio Control Equipment (RCE)

Purpose: This project will replace the present radio control equipment to improve operational performance and reduce maintenance cost. RCE provides an integrated system approach to remote radio control, remote environmental sensor and maintenance monitoring, and emergency back-up battery power. The RCE integrates each control facility with all of its associated remote facilities into a single monitoring and control subsystem based on a modular building block design and system level software. The subsystem has fault detection and reconfiguration capabilities, which may be accomplished locally or remotely with a RMMS maintenance data terminal. The RCE modular construction accommodates the FAA's various size requirements for ARTCC, TRACON/ATCT, AFSS, and ACF control facilities and their associated remote facilities.

Approach: The approach is to replace existing point-to-point Voice Frequency Signaling Systems (VFSS) and keying control equipment with modern system-based equipment which uses presently available hardware and software technology.

The initial contracts under this project provide equipment to replace VFSS and keying control equipment at ARTCCs and selected high activity TRACON/ATCTs, and their associated RCAG, RTR, or RCF facilities. The contracts also provide options for completing current equipment replacement at high activity TRACON/ATCTs, ARTCC/ACFs and AFSSs and their associated RCAG, RTR, or RCF facilities.

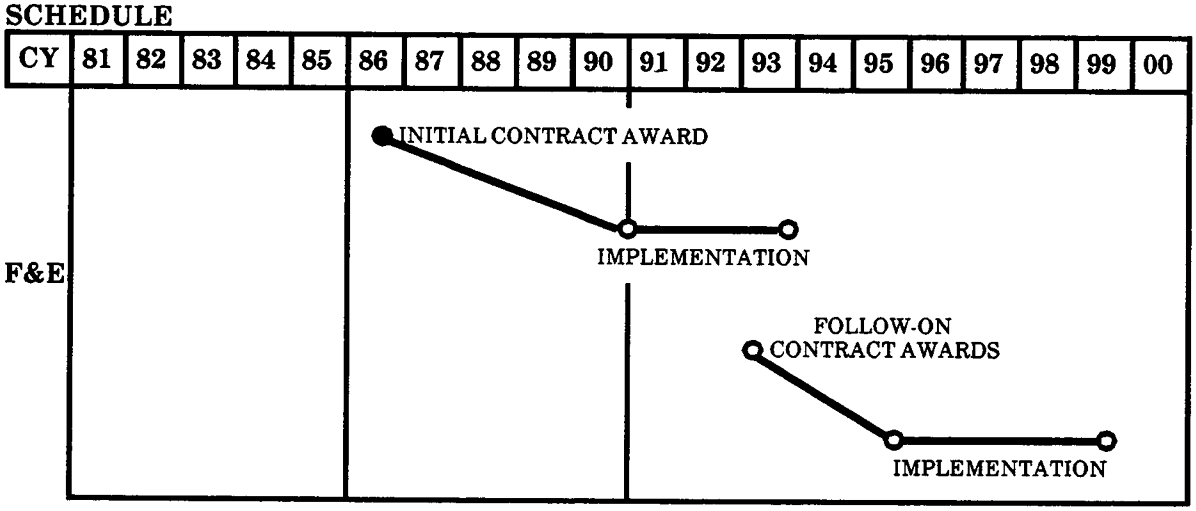
Radio control equipment for the AFSSs may be obtained by a separate contract. This determination will be based on cost-benefit analysis of alternatives for meeting less stringent requirements of AFSS services.

Products: Replacement of approximately 2,950 channels of VFSS and keying control equipment associated with ARTCCs, TRACON/ATCTs, and ARTCC/ACFs starting in FY 90.

Installation of 1,830 channels of RCE for AFSS applications starting in FY 95.

Related Projects/Activities: The radio control equipment will perform the radio channel signaling and control functions to support ground/air voice communications and connectivity between the voice switching equipment in the operation of air traffic control facilities. This includes VSCS in ARTCC/ACFs, ICSS and TCS in ATCTs, ICSS in AFSSs, and the ground/air radio equipment in the remote communications facilities for RMMS.

SCHEDULE



CHAPTER VI

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS

gency programs; and the facility and equipment (F&E) process itself.

This chapter focuses on improvements to flight inspection capabilities, maintenance support, emergency systems, power systems, structures, laboratories, and environmental support facilities.

The flight inspection program certifies the operation of FAA facilities that transmit the precision signals needed for navigation and surveillance. Currently, about 23,000 hours of flight inspection operations are performed annually out of five flight inspection field offices, a reduction from 27,000 hours and seven field offices in 1981. These operations include initial certification of new facilities, periodic inspections of facilities under FAA regulations, and certification of facility performance following accidents.

Maintenance support is accomplished by a staff of electronic and environmental technicians from approximately 650 duty stations associated with 79 sector offices. This reflects a reduction from 115 sector offices and approximately 1000 duty stations in 1981. This support usually consists of corrective and periodic preventive maintenance. It requires frequent site visits and, in some cases, the staffing of facilities to assure immediate response in the event of a required maintenance action.

Training for most of the technical work force is performed locally and at the FAA Academy in Oklahoma City. Training capabilities include resident training along with computer-based instruction and some correspondence courses. Execution of the FAA National Airspace System Plan will result in a modernized and cost-effective air traffic control system. Life-cycle support of new and existing systems must be equally cost-effective.

the operational systems, technical support of field personnel, and operational testing and evaluation of new systems.

National field engineering support is provided by a cadre of technical experts. Support for operational automated systems is accomplished by a team assigned to the FAA Technical Center. Support for non-automated systems is provided by a team headquartered at the Mike Monroney Aeronautical Center. Logistics support is provided by the FAA Depot located at the Aeronautical Center.

Emergency communications are presently conducted via a network of high-frequency, single-sideband equipment. The network provides management of the capability for continuing or restoring operations in cases of severe weather, national disasters, and other losses of normal communications channels. It is also a means of non-secure backup communications of defense readiness situations. The local FM networks provide limited communications capability for routine and emergency requirements with remotely located maintenance personnel. The evolution of the NAS is greatly dependent upon the efficient use of the radio frequency spectrum.

Support for environmental facilities is consistent with the general technology of FAA systems. There is still in existence a small amount of vacuum-tube technology which requires frequent maintenance and the provision of heating, ventilation, and air conditioning. In many cases, the electric power supporting this equipment necessitates the use of engine generators as backup power systems. Air conditioning, heating, and buildings are set up to provide an environment for the equipment as well as for the maintenance staff. In some remote areas, particularly in Alaska, the FAA provides employee living quarters and other public services.

control and air navigation services, require a planned evolution of supporting capabilities and equipment.

The Maintenance Program for the 1980s has been developed to address the evolutionary change in system maintenance. It is based on the following: implementation of solid-state technology, introduction of remote monitoring, control and certification, centralization of the work force, improved centralized repair facilities and decentralized training capability. The individual systems specialist will continue to be the most important link in system integrity. Maintenance automation aids, power systems, environmental systems, and structures improvements, in combination with the replacement of all vacuum-tube technology systems, will allow for increased productivity and decreased cost.

Instead of periodic preventive maintenance and frequent site visits, automated aids will allow FAA to monitor system performance continually from maintenance control centers. This will reduce travel requirements and cost. Also, by using remote monitoring techniques, the FAA can eliminate manning of many facilities and consolidate maintenance personnel into a relatively small number of centralized work centers without harm to service. Onsite corrective maintenance at remote locations will be limited to replacement of line replaceable units (LRUs). This will minimize both service restoration time and the requirement for costly test equipment at these locations. Due to the increased complexity of hi-tech modules, LRU repair will be performed at a high technology repair facility, which will be equipped with the necessary diagnostic and test equipment, and staffed by skilled personnel.

Elimination of staffing at remote facilities depends partly on the replacement of engine generators and removal of other systems that require onsite personnel.

similar evolution. New technology, more fuel efficient aircraft, new system capabilities for automatic flight inspection, past consolidation of the work force, and policy changes will allow for orderly transition from the old to the new with no decrease in safety while reducing operating costs.

The FAA's system support has been geared to support the existing systems while a full-scale effort is underway to produce the capabilities required in the future. A system engineering and integration contract has been awarded which provides for management assistance and technical support for the implementation of the NAS Plan. Additionally, another contract has been awarded to provide technical support services and materials to assist regions and centers to augment their efforts in accomplishing NAS improvement implementation.

The emergency command, control, and communication capability will be provided nationally with a radio network of HF and FM equipment.

Frequency engineering and management is a critical activity to assure interference-free operation of the many FAA facilities. Electromagnetic compatibility aspects make close monitoring of frequency assignments a must.

Two major laboratories located at the FAA Technical Center will be upgraded for use in the testing and evaluation of new systems prior to and during field use. The system support laboratory (SSL) will be used for: direct assistance to field facility technicians; development and testing of systems; hardware, software, and firmware modifications; and support of new development activities. The general support laboratory (GSL), consisting of general purpose systems, facilities, and aircraft, supports the SSL as well as most other center activities.

efforts are well underway. Almost all VORs and VORTACs have been replaced with RMM-compatible equipment. Thirty-eight maintenance processors have been purchased and installed. Testing and evaluation of operational hardware, software, and concepts are being accomplished.

Initial operational requirements for the maintenance control centers have been defined and a general NAS (GNAS) prototype established. Four hundred and twenty-nine computer-based instruction terminals have been acquired and installed to provide technical and proficiency training in the field.

Airport selection criteria for installation of large airport cable loops have been completed and power system standards development is well underway. The installation of a prototype cable loop system has been completed.

Power conditioning systems for ARTS IIIs have been installed at the higher-priority locations. Power system improvements such as lightning surge protection and improved grounding, bonding, and shielding are being accomplished before solid-state equipment is installed. Engine generator refurbishment, replacement in-kind, replacement with battery backup systems and line conditioning equipment have begun.

Unmanned facility evaluations and improvement program plans have been completed as are the first facility standard designs. Sixty AFSS sites have been selected. Over half have been completed or under construction.

The number of Airway Facilities sectors has been reduced to 82 from 115 in 1981.

NADIN IA, FDIO, and host systems have been installed.

NEAR TERM (TO 1990)

During this period many of the individual projects will be completed or near completion. To enhance these efforts, a technical support and materials services contract has been awarded to supplement regional, Aeronautical and Technical Center efforts necessary for implementation.

During this period the remote maintenance monitoring system (RMMS) and maintenance control center (MCC) projects will result in substantial benefits. The maintenance control centers will continue to be implemented, serving as the nerve center of the maintenance function. CBI expansion will continue. It will allow for less centralized training, specifically in the proficiency training area. Airport cable loop installations will be completed at some of the priority locations identified by the regions. Power conditioning systems for all ARTS III systems will have been provided. Major structural, heating, ventilation, and air conditioning modernization work will be underway at nearly all ARTCCs and many unmanned facilities.

The sectors will provide some repair of modules and replacement of failed parts. Repair of hi-tech and difficult-to-repair items will continue to be accomplished at the FAA Depot.

Environmental RMM for HVAC, power systems, and unmanned facilities will be underway allowing reduction in workload and site-visit frequency. Buildings which house the automated flight service stations will have been acquired either through lease or construction.

flight inspection instrumentation will be in use for global and domestic service. An emergency communication network will be in place as a result of interfacing the backbone network with the eastern and western command networks and some regional FM networks.

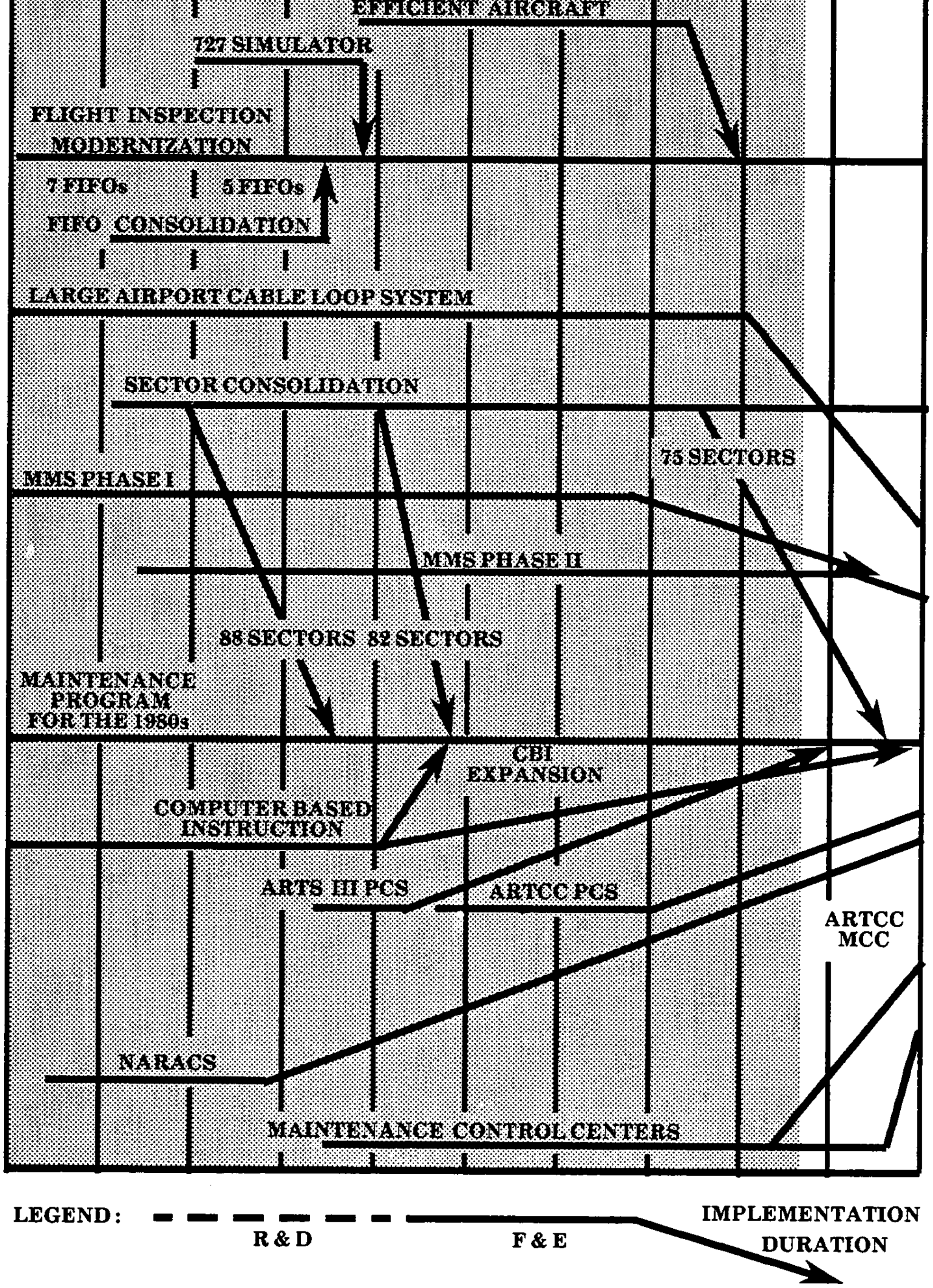
Support laboratories at the FAA Technical Center will continue to be upgraded in keeping with the establishment of new systems in the NAS.

provements will have been completed. More reliable cable loop systems will serve large airports.

The system engineering and integration and the technical support and materials services contracts extension options will expire in 1994 and 1997 respectively. At that time, the originally identified NAS Plan projects should be substantially complete.

The support laboratories, both systems and general, will be focusing more on installed system modification and improvements instead of initial tests and evaluation.

The following diagram and maps describe the evolution of the system.



EFFICIENT AIRCRAFT
727 SIMULATOR
FLIGHT INSPECTION MODERNIZATION
7 FIFOs
5 FIFOs
FIFO CONSOLIDATION
LARGE AIRPORT CABLE LOOP SYSTEM
SECTOR CONSOLIDATION
75 SECTORS
MMS PHASE I
MMS PHASE II
88 SECTORS
82 SECTORS
MAINTENANCE PROGRAM FOR THE 1980s
CBI EXPANSION
COMPUTER BASED INSTRUCTION
ARTS III PCS
ARTCC PCS
ARTCC MCC
NARACS
MAINTENANCE CONTROL CENTERS
LEGEND:
R & D
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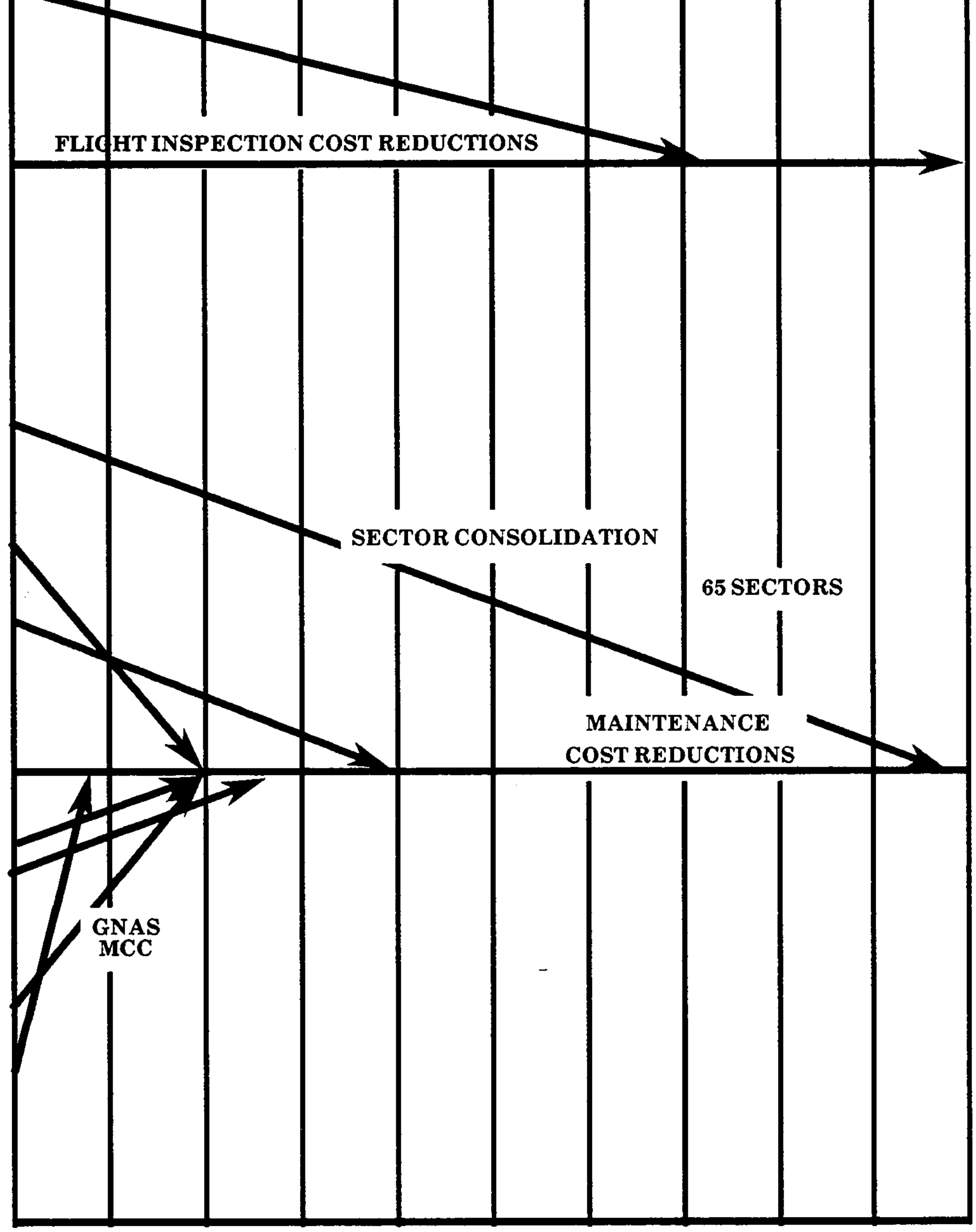
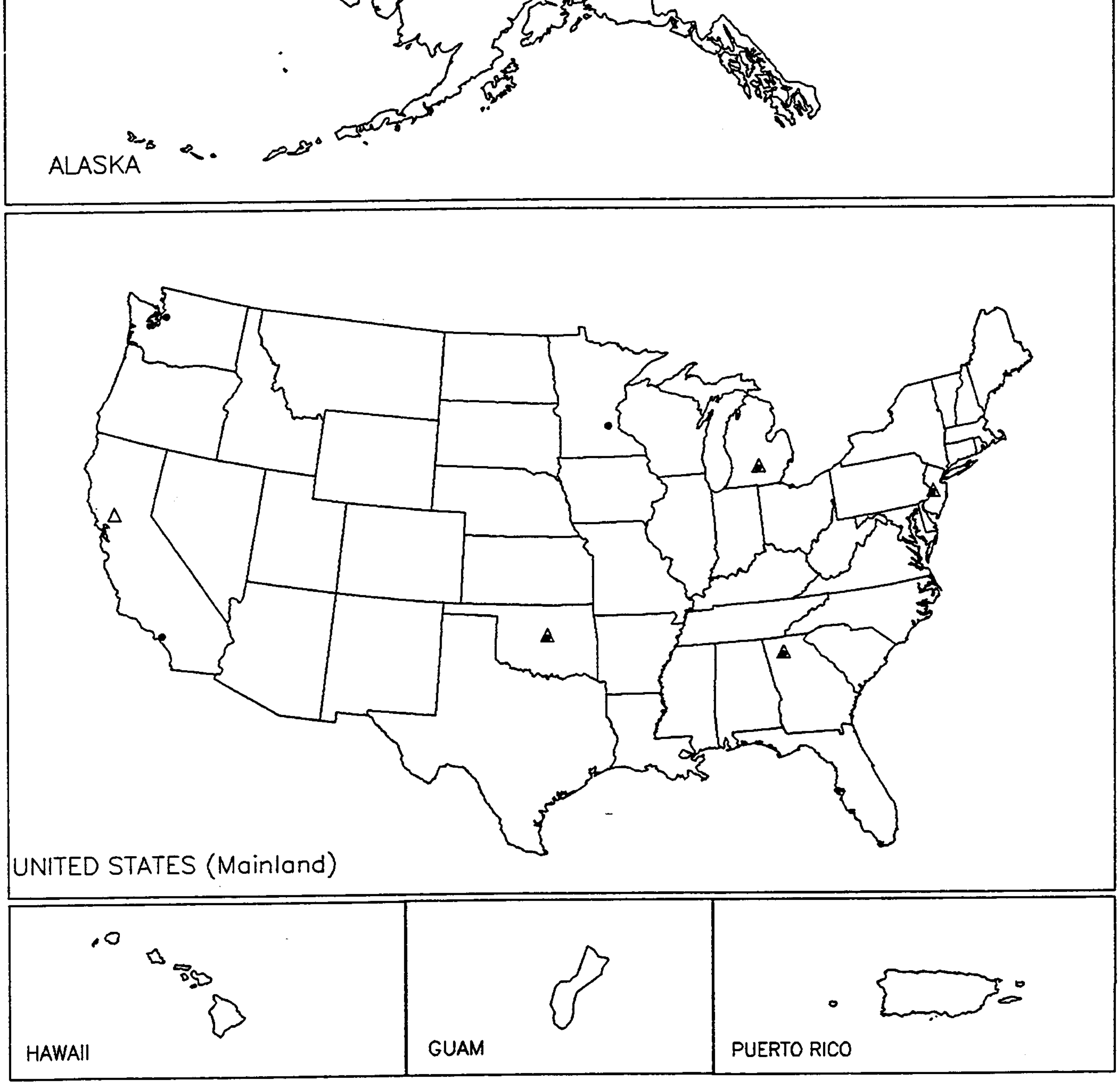


MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS EVOLUTION

● 1981 FLIGHT INSPECTION FIELD OFFICES

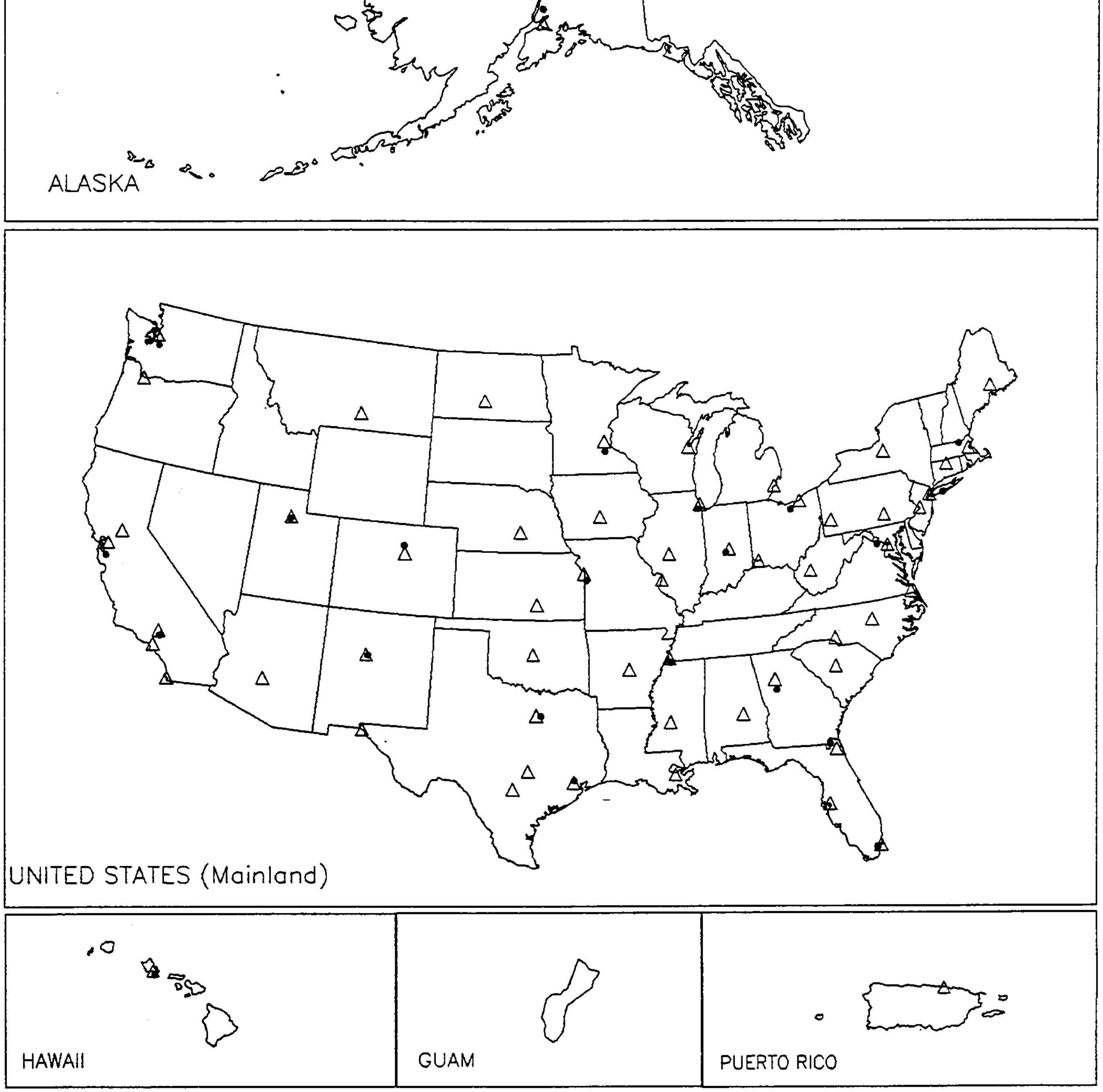
△ 1987 FLIGHT INSPECTION FIELD OFFICES



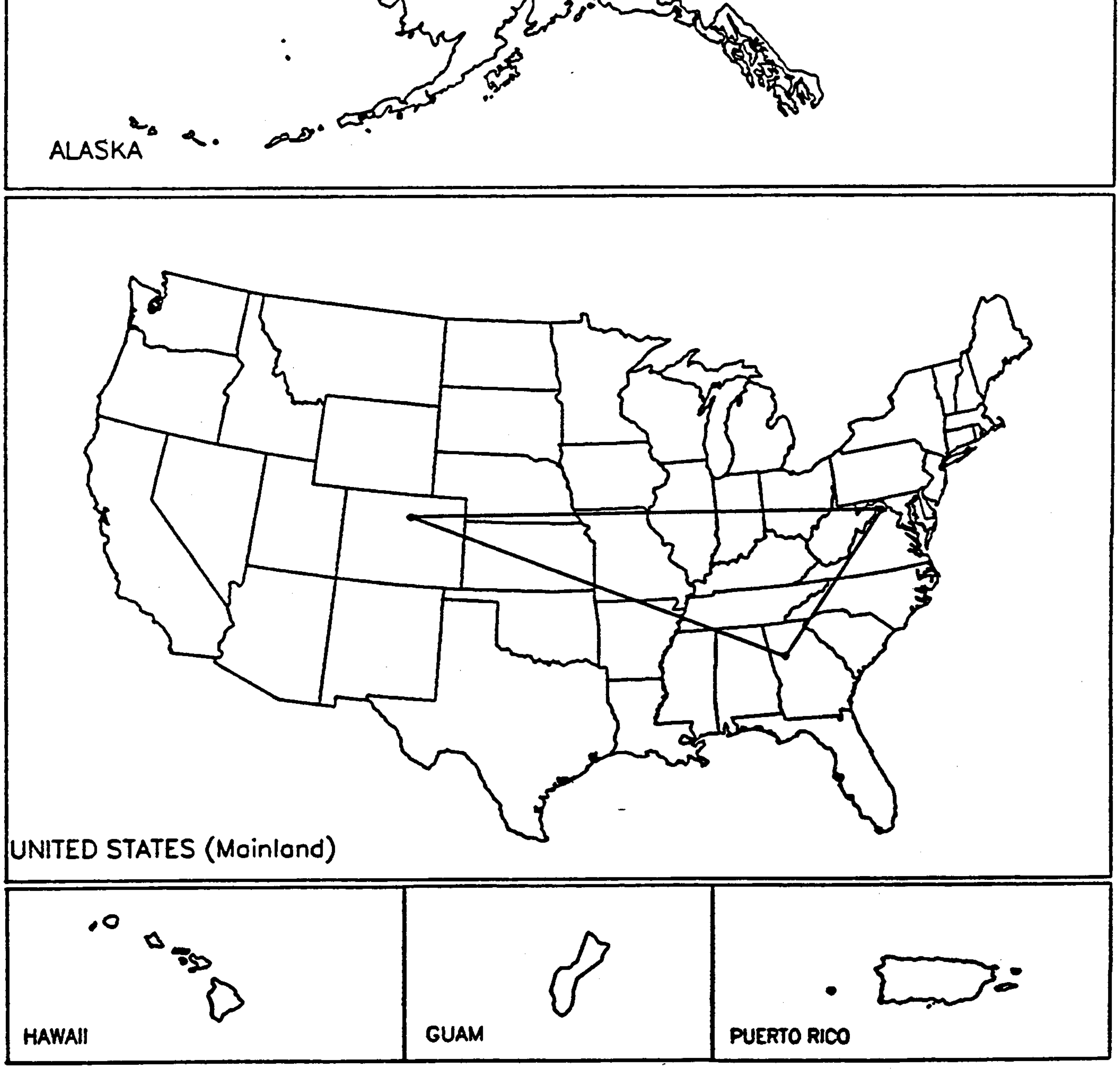
FLIGHT INSPECTION FIELD OFFICES

● ARTCC SECTOR OFFICES

△ GENERAL NAS SECTOR OFFICES (INCLUDES NATCOM)



1989 AF SECTOR OFFICES

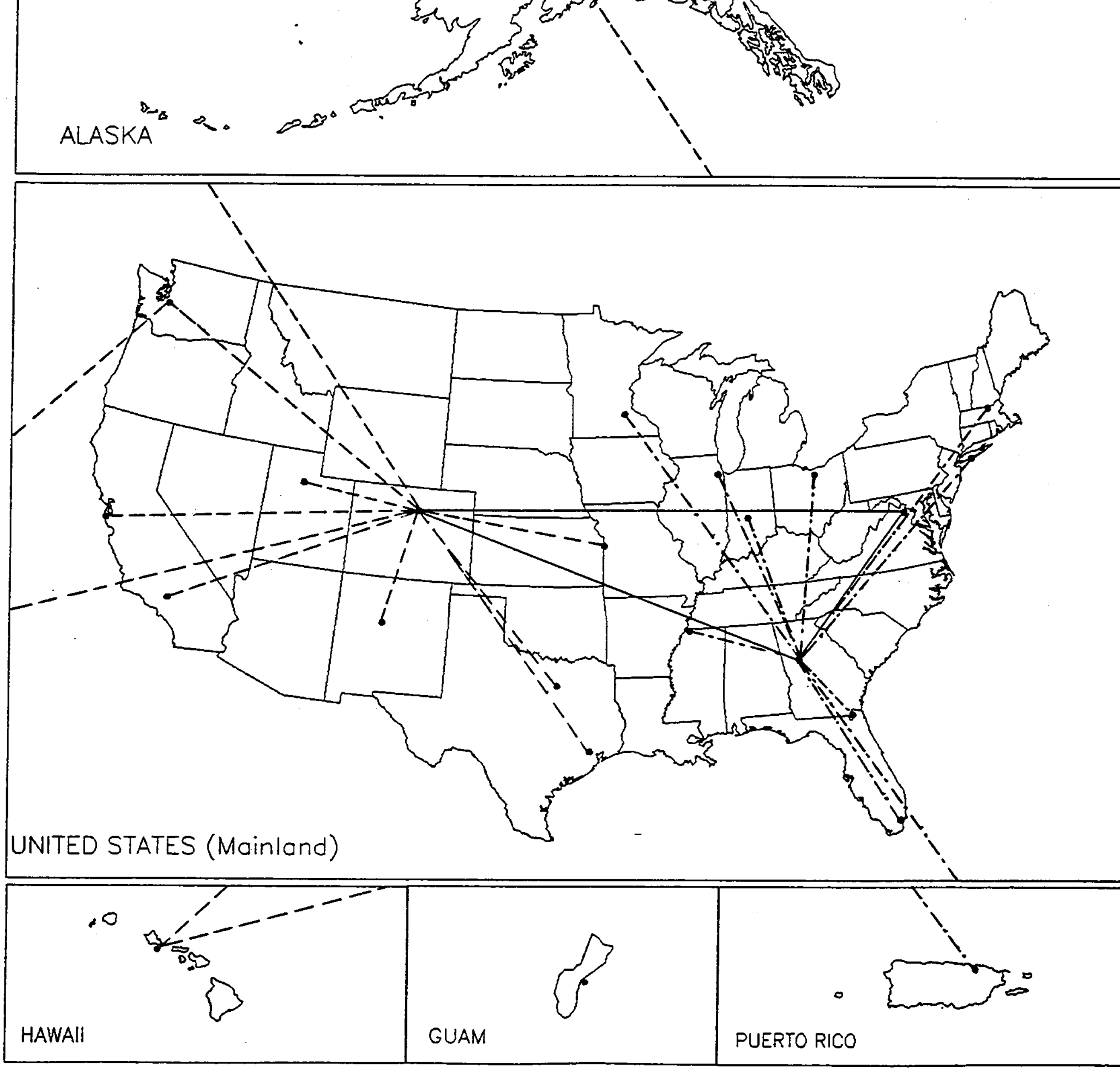


1981 SYSTEM
NATIONAL EMERGENCY COMMUNICATIONS SYSTEMS

HF/SSB BACKBONE

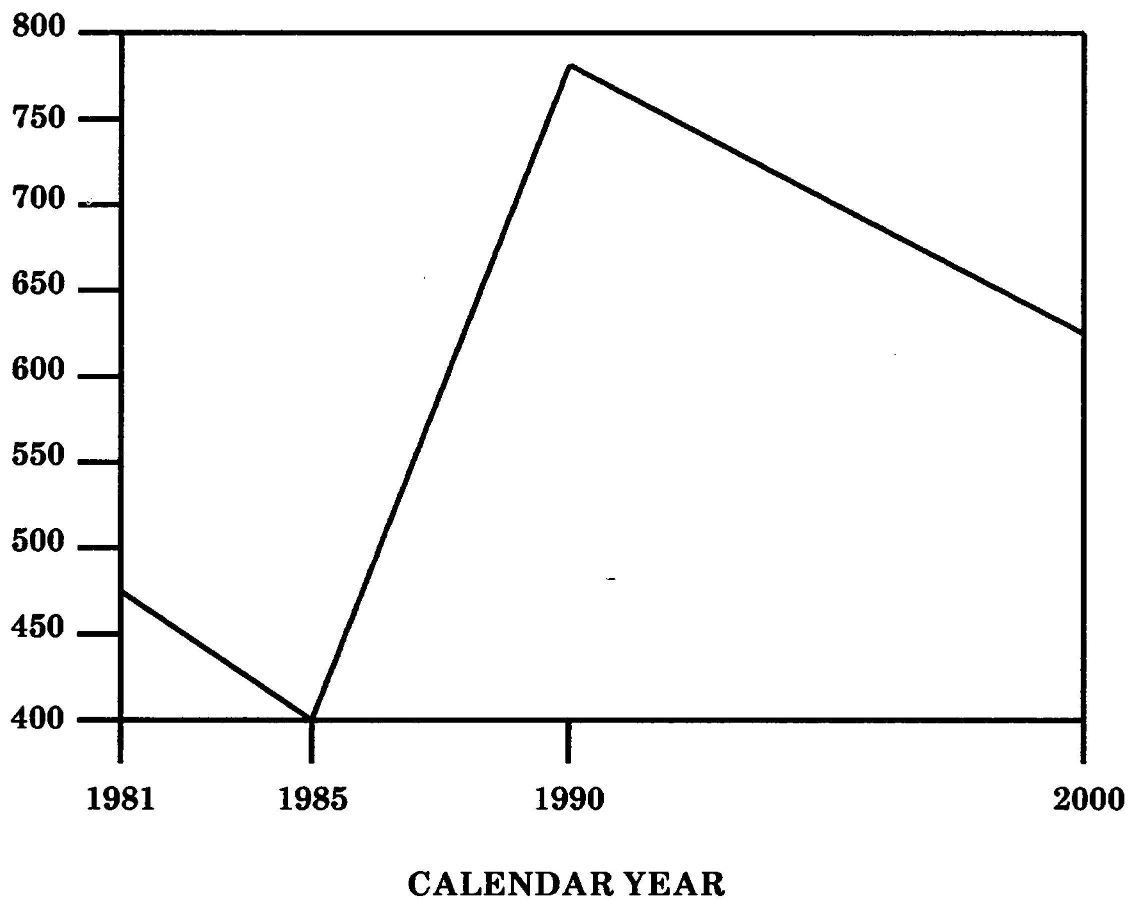
WESTERN COMMAND NET

EASTERN COMMAND NET



1990 SYSTEM
NATIONAL RADIO COMMUNICATIONS SYSTEM (NARACS)
(HIGH FREQUENCY SYSTEM)

operations support system will undergo significant changes in hardware and plant improvements which will result in a more efficient maintenance work force. The apparent increase in staffing for the maintenance operations and support system beyond required to staff the maintenance and operations support system. Air Traffic, FAA Academy, and national field support group staffing are not included in this data.



AIRWAY FACILITIES EMPLOYMENT
(MAINTENANCE AND OPERATIONS SUPPORT)

reduction in the number of site visits required to maintain the facilities.

1990 - Staffing levels will increase to 783 to provide continuous monitoring at the MCC of the ARTCC and selected remote facilities. Remote Maintenance

1981 to 7,735 in the year 2000.

AF sector offices will be reduced to 65.

Outyear estimates are reviewed annually and are subject to revision.

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS (1981 Dollars)

	1981	1985	1990	2000
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Airway Facilities Personnel	473	401	783*	624*
AF Productivity Quotient	320,296	357,855	186,590*	296,635*
Airway Facilities Personnel Costs (Thousands)	$16,129	$13,674	$26,700	$21,278

* Staffing associated with ARTCC and GNAS MCC's is included for 1990 and subsequent years.

enable them to operate. Supporting functions, including maintenance, engineering, and flight inspection and testing, similarly require capital investment to ensure successful implementation and maximize potential cost savings. The projects are grouped into five basic improvement categories: maintenance, power, structures, aircraft, and system improvements.

Maintenance improvements in the form of the remote maintenance monitoring system and maintenance control centers will allow for the implementation of the 1980s maintenance concept, which provides for remote monitoring of new and retained equipment, automated record keeping, and improved utilization of the maintenance work force. Facility performance will be assured at maintenance control centers which will be the nerve center of systems maintenance. Training of technical, operations, and safety personnel will be improved by the expansion of computer-based instruction.

heating, ventilation, and air conditioning account for the majority of activity in this section. Other efforts include the acquisition of automated flight service station (AFSS) buildings.

Aircraft improvements provide for replacement of obsolete aircraft with modern fuel-efficient aircraft. In support of projects in other chapters, this will reduce flight inspection costs and add new avionics equipment to the FAA aircraft fleet to keep pace with system improvements and addition of new services.

System improvements encompass support activity for the NAS such as general support activity, technical services and materials to supplement field implementation efforts, frequency spectrum engineering and management, NAS system engineering and integration assistance, and the upgrading necessary for the general and support laboratories. The national radio communications system is included which will provide emergency command and control communications capability without need for land lines.

2. Computer Based Instruction (CBI)	1982	1990
3. Central Repair Facility (CRF)	PROJECT	DELETED
4. Maintenance Control Center (MCC)	1985	1992
POWER IMPROVEMENTS		
5. Large Airport Cable Loop Systems	1989	1992
6. Power Conditioning Systems for Automated Radar Terminal Systems III (ARTS III)	1985	1989
7. Power Systems	1981	1992
STRUCTURES IMPROVEMENTS		
8. Unmanned FAA Airway Facilities Buildings and Plant Equipment	1983	1992
9. ARTCC Plant Modernization	1984	1997
10. Acquisition of Flight Service Facilities	1983	1992
AIRCRAFT IMPROVEMENTS		
11. Aircraft Fleet Conversion/Flight Inspection Modernization	PROJECT COMPLETE	1988
12. Aircraft and Related Equipment	1983	1998
SYSTEM IMPROVEMENTS		
13. System Engineering and Integration Contract	1984	1994
14. National Radio Communications System (NARACS)	1983	1993
15. NAS Spectrum Engineering	1982	1992
16. General Support	1981	1992
17. System Support Laboratory	1981	1998
18. General Support Laboratory	1983	1992
19. Technical Support Services	1988	1997

PROJECT SUMMARY

increase work force productivity. When fully implemented, remote maintenance monitoring will permit substantial savings in operating cost and manpower.

Approach: Implement the RMMS in an evolutionary fashion to assure a smooth transition of the maintenance automation program.

Remote Monitoring Subsystems (RMSs) will be employed to collect, store and transmit performance data and to provide the means to remotely adjust, certify, and/or reconfigure the facilities. Systems which are deployed and do not have remote maintenance monitoring (RMM) capabilities will be equipped with RMSs according to the needs of the maintenance workforce. All newly designed systems will have RMM embedded.

Remote Monitoring System Concentrators (RMSCs) will collect data from a group of RMSs, typically at airports, for transmission to the control and monitoring locations. The concentrators will be placed where it is cost-beneficial to reduce leased communications costs. It is estimated that up to 750 concentrators will be required to complete the total end-state RMM network.

Maintenance Data Terminals (MDTs) will be used to access the RMM Network, and will be provided in two phases. Initial quantities of approximately 600 will be bought in FY 89 to establish the basic system capabilities. Additional MDTs will be purchased from FY 89 through FY 93, as system needs dictate.

Maintenance Processor Subsystems (MPSs) have been installed at all ARTCC and 10 GNAS Sectors to

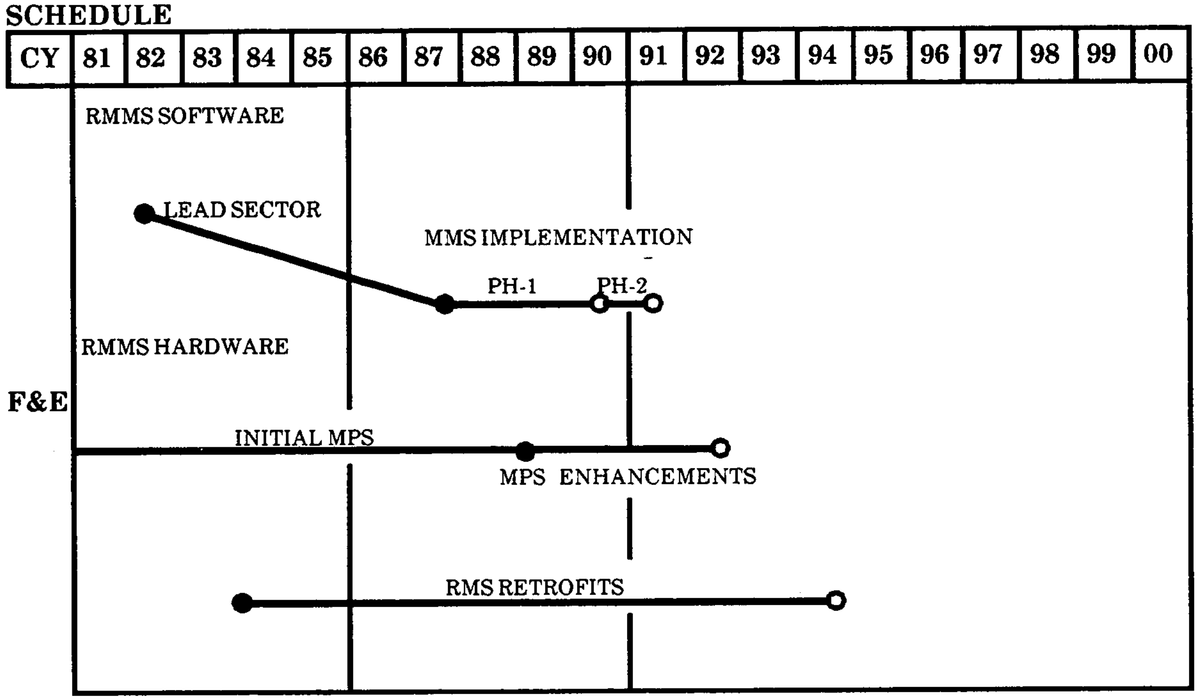
is being provided (to run concurrently with MCS in the MPSs) to permit the use of facility data at sectors, work centers, regional offices, and FAA support organizations. MMS will be implemented in two phases: Phase 1 currently provides basic information gathering functions, such as automated facility logs, performance reporting, preventive maintenance scheduling, and a facility, service, and equipment profile data base. Phase 2 will add additional record keeping functions, such as facility modifications, inspections, configuration management, energy management, and personnel training and certification.

Products:

- RMMS Software - Interim and final monitoring/control software, and maintenance management system software.
- RMMS Hardware - 38 MPSs at ARTCC, GNAS and field support sectors; up to 750 RMSCs; up to 5000 MDTs.
- RMS Retrofits - For ARSR, ATCBI, CD, ILS, and other facility types shown to be cost beneficial.

Related Projects/Activities: The establishment of remote facility monitoring and control from central locations will require coordination and interfaces with all NAS Plan activities, the most significant being: MCC, program offices with RMS requirements, the Advanced Automation and ACF projects, and all Interfacility Communications projects.

SCHEDULE



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RMMS SOFTWARE
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MMS IMPLEMENTATION
PH-1
PH-2
RMMS HARDWARE
F&E
INITIAL MPS
MPS ENHANCEMENTS
RMS RETROFITS

required by Airway Facilities because of the high reliability of the new equipment and the new maintenance philosophy. Where possible in Airway Facilities, CBI will be used at local or field sites and will form the nucleus of field-conducted training. In other cases CBI will be coupled with hands-on equipment training at the FAA Academy. Simulations permit an increase in learning apart from the actual equipment.

CBI promotes the accomplishment of the agency mission by:

- Significantly reducing the current travel costs associated with centralized training.
- Improving the efficiency and productivity of existing facility training staffs.
- Providing flexibility in scheduling and conducting training according to the individual's and facilities' unique needs.
- Allowing for greater local management control of the training schedules and resources.
- Making standardized onsite proficiency/update training more available.
- Fostering improvements in employee productivity.

Approach: Establish CBI learning centers with hardware/software/courseware where there are concentrations of field personnel. Additionally, existing hardware/software will be upgraded.

provided by the U.S. Army at Redstone Arsenal as part of an intergovernmental software support system. This is accomplished using some new and some existing leased circuits via an FAA multiplexing modem network. This approach is significantly less expensive than procuring additional leased circuits for each terminal.

Additionally, considerable telecommunications costs have been avoided in the Air Traffic CBI program because the majority of the courseware is suitable for delivery in an off-line mode using disk drives. Lines are used only to transfer student records or other training information. The Airway Facilities CBI program requires the greater capacity of the on-line CBI system, but future technology may make this capability available in an off-line format.

Products: By 1985 there were a total of 429 CBI terminals accompanied by disk drives at 182 locations. Printers were provided at each location.

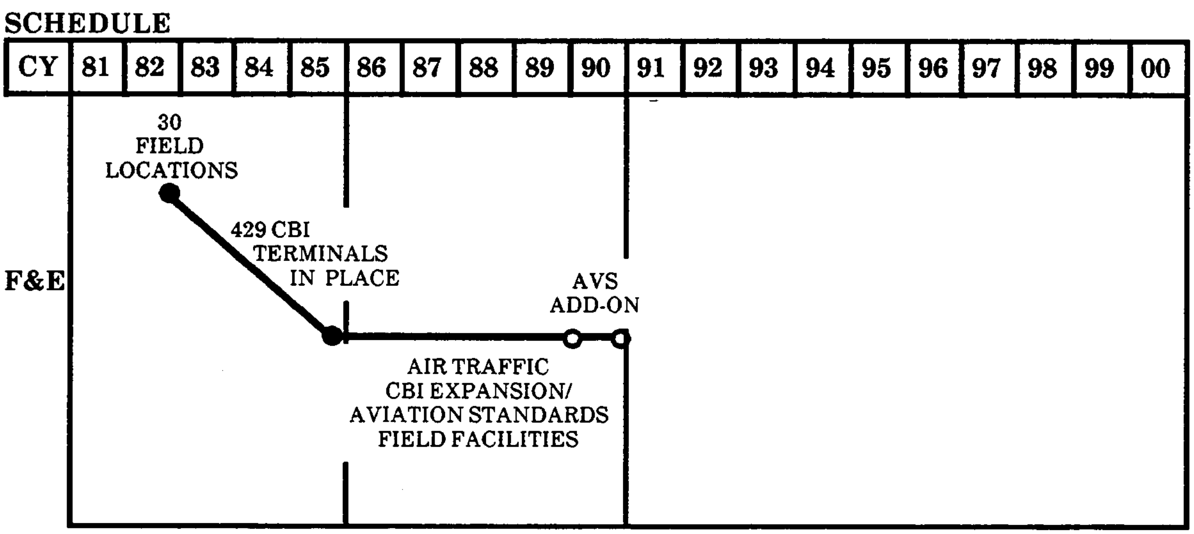
• Airway Facilities sector offices	131
• Flight inspection offices	7
• ARTCCs	150
• Airport Traffic Control Towers, Levels IV & V	83
• FAA Academy	46
• Regions/centers/Washington headquarters	12

By December, 1989, 438 terminals with disk drives will be provided for 218 Level III Airport Traffic Control Towers, 159 Level II Towers and for 61 Automated Flight Service Stations. A substantial training workload exists at the lower level towers where the ongoing operational needs preclude dedication of staff personnel to perform required proficiency training.

- Airport Traffic Control Towers, Level II [illegible]
- Automated Flight Service Station 61

In 1989, 100 CBI learning stations were budgeted to improve safety inspector training in Aviation Standards field facilities. The requirement is in accordance with Project SAFE (Safety Activity Functional Evaluation) and addressed in the comprehensive review, a Blueprint for Flight Standards. Project SAFE is a product of a Secretary

Personnel and Technical Training (APT), each service and the Aeronautical Center (AAC). We anticipate the need to upgrade each CBI training center at a minimum of 7-year intervals. This project will require interfacility communications service from NICS. Projects providing service include Data Multiplexing and RML Replacement and Expansion. Chapter VII contains the requirements for system expansion/enhancements for the period 1989 through 1997.



(natural/defense/accident) as well as the primary interface between ATC operations and maintenance/support activities. The final configuration will be the result of an evolutionary process incorporating the monitoring of new subsystems as they become part of the National Airspace System.

Approach: Lead sector studies were completed which established the initial procedures and requirements for MCCs at ARTCC and GNAS sectors.

Centralized monitor and control capabilities include:

- ARTCC/ACF MCCs (AMCC) will be established in each ARTCC/ACF to enhance NAS performance monitoring and service restoration and will include a Maintenance Control Center Processor (MCCP) and Maintenance Monitor Console (MCC). The existing Systems Maintenance Monitor Console will be replaced with a Maintenance Control Center Processor/Maintenance Monitor Console (MCCP/MMC) to consolidate the monitoring devices already deployed. The MCCP/MMC will be augmented to incorporate the monitoring functions of new subsystems as they transition into the NAS. A prototype system was deployed to Atlanta in December 1985.

- GNAS MCCs (GMCC) will be established at each sector to provide a central focus for the facility restoration activities. The GMCC consists of an MCC workstation (GMCC-WS) which includes information from remote facilities as well as co-located facilities. Processed data (status reports and/or alarms) will be displayed to specialists at this central location. These specialists will be able to take action as appropriate via the remote maintenance monitoring system or co-located automation and interfacility communication systems.

Products:

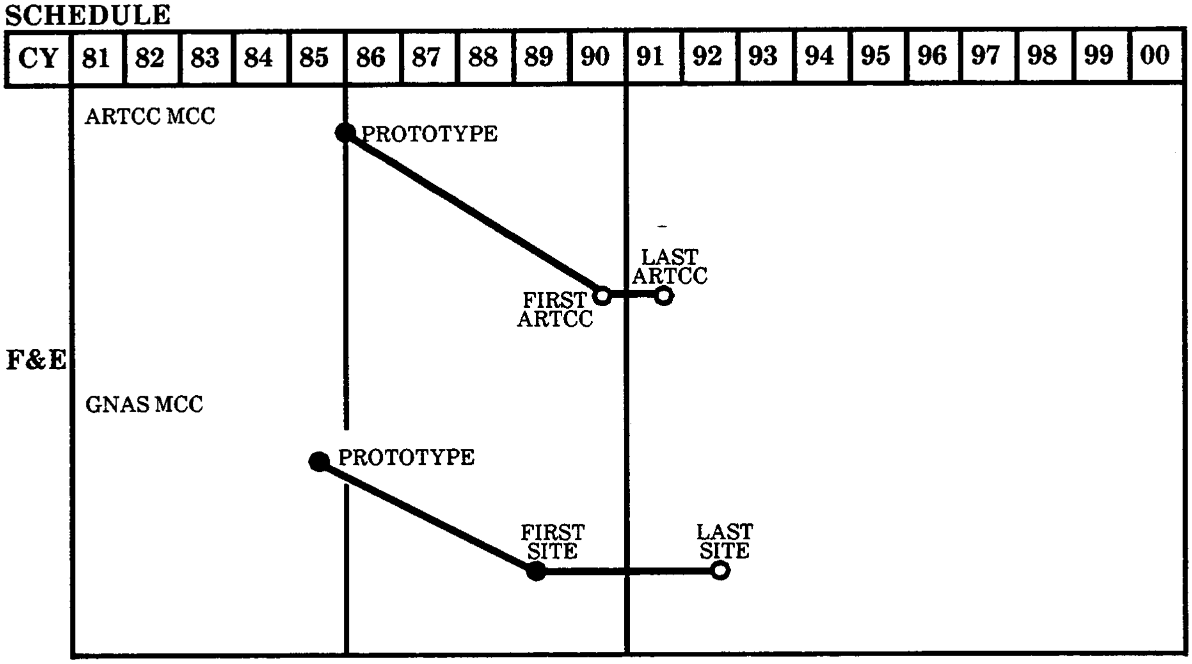
- AMCC - A prototype was completed in 1985; production units will be deployed to all ARTCCs, the FAA Technical Center, and the FAA Aeronautical Center by 1991.

- GMCCs will be established at GNAS sectors to focus the RMM capabilities within specific geographical boundaries.

Other products include the establishment of uniform functions and operating procedures, providing for training and space requirements, and developing the capability to direct and utilize the technical work force effectively.

Related Projects/Activities: Systems implemented by this project will utilize capabilities provided by the remote maintenance monitoring system. The establishment of remote facility monitoring and control from a central location will require interfaces and coordination with all NAS program activities implementing RMM capabilities.

SCHEDULE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LAST SITE

consolidation and relocation projects as well as replacement of deteriorated cables should be included. Reliable signal distribution, utilizing fiber optic or other technology, will be provided through the provision of new or the upgrading and replacement of deteriorated cables at major airports and the reconfiguration of them into loop systems.

The reconfigured cable network distribution will:

- Eliminate outages caused by deteriorating or failing cables.
- Allow cable repair with minimum outage time.
- Provide for better planning of airport cable systems.
- Minimize the number of small engine generators.

Additionally, fiber optic or other technology installation will:

- Provide for greater capacity than metallic conductor cables.
- Permit system growth with minimal additional cables.
- Eliminate cable damage from lightning surges.
- Reduce electromagnetic interference.

Approach: Each region will develop a master plan for the cable systems for those major and intermediate activity level airports qualifying on a cost-benefit basis. The master plan will provide for the Outage time resulting from cables damaged accidentally by animals or environmental factors will be minimized through fault sensing and switching of power, communication, and control cables.

An engineering analysis will determine the cost versus benefits of establishing the system scheme (loop network configuration) in comparison with the current approach of replacement in-kind and establishment of individual facility cables.

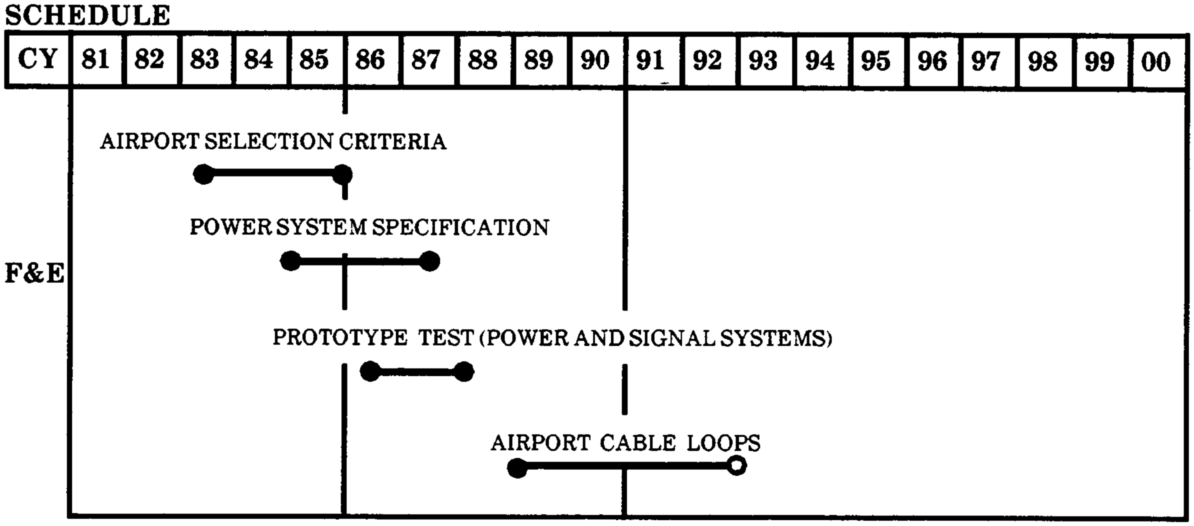
Products:

- More reliable and flexible power and/or signal distribution systems at 100 airports.
- Power system standards.

Related Projects/Activities: Planning for each airport will include the power, control, and communications needs since there are obvious benefits in providing cable ducts or direct earth burial concurrently. Noise and external interference will be minimized by proper spectrum engineering. Cost avoidance is also possible by coordinating the cable loop activities with other airport construction, either by FAA or airport management, such as MLS installations and runway extensions. Loop switching devices will have RMM capability. The Airport Telecommunications project is closely related as it provides the specifications and criteria for employing new-signal system technology such as fiber optics and RF data links.

Continuing effort for the period after 1992 will be provided in the sustained NAS Support Project in Chapter VII.

SCHEDULE



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F&E
AIRPORT SELECTION CRITERIA
POWER SYSTEM SPECIFICATION
PROTOTYPE TEST (POWER AND SIGNAL SYSTEMS)
AIRPORT CABLE LOOPS

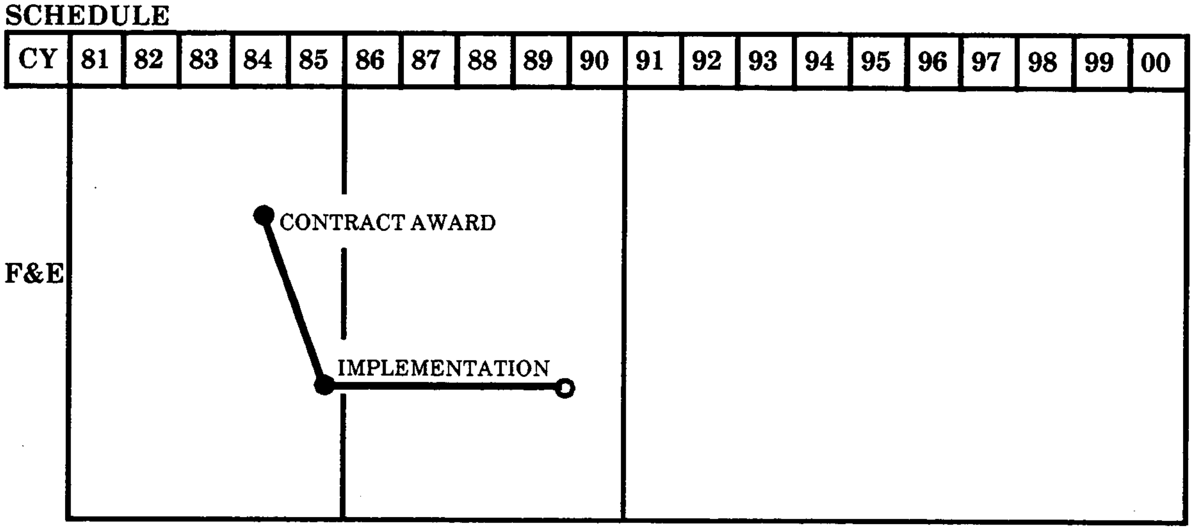
2 seconds; whereas, ARTS III may go into a momentary "save data" mode if power is out of tolerance for 17 milliseconds. The ARTS IIIA may require 30 to 45 seconds to restore operation after return of acceptable power.

This program will increase the reliability of electrical power so that it will approach 100 percent (AWANS), and dual and triple RML facilities.

Products: Sixty commercially available, off-the-shelf, Uninterruptible Power Systems (UPS) (plus one support system at the FAA Depot and one support system at the FAA Aeronautical Center).

Related Projects/Activities: None.

SCHEDULE



sources were best satisfied by engine generators. New electronics technology results in significant reductions in its energy consumption and related environmental support systems. New long-life batteries are now a practical alternative to small standby power engine generators. Battery standby power systems provide for increased facility availability, reduced operating costs, and reduced overall energy consumption. Also, recent technological advances in alternate power sources such as photovoltaics, fuel cells, and wind generators now offer a potential cost savings for prime power sources at locations when commercial power is not readily available. This program will accomplish the removal of replaced engine generators and the retrofit of existing facilities with battery standby power system, cost-effective alternate prime power system, and power conditioning equipment.

Many FAA structures and facilities do not have adequate lightning protection systems installed. In addition, some facilities have obsolete wiring and inadequate grounding, bonding, and shielding. Lightning surge protection devices must be improved at many facilities; and deficiencies in wiring, grounding, bonding, shielding, and code violations must be corrected.

In the future, most facilities will be unmanned and may normally be operated at lower temperatures in cold weather and higher temperatures during hot weather. Environmental RMS is expected to reduce the number of scheduled maintenance trips from monthly to quarterly as well as reducing the time required to perform scheduled performance checks.

The modernization of critical power systems at major manned facilities is also part of this project. The power conditioning system (PCS) at ARTCCs is investigated and recommended improvements made to provide increased reliability.

Approach: Develop a national plan and criteria to improve power quality where required to satisfy facility mission requirements. Modifications will be made to standby power systems (replacement of small engine generators with batteries and dc distribution systems) and power transfer systems. Large engine generators will be overhauled or replaced. Remote maintenance monitoring systems will be utilized to permit monitoring, certification, and control. Approximately 2,000 smaller engine generators (30 kW and below) are in need of replacement with batteries and dc distribution systems as facilities are converted to solid state. Approximately 1,000 engine generators require overhaul or replacement. Other commercially available power sources will be introduced for use in the FAA.

Line conditioning, lightning surge protection and grounding, bonding, and shielding efforts will be continued to upgrade existing equipment to the latest state-of-the-art. Power conditioning devices will be provided to correct other known deficiencies. Replacement of obsolete wiring to meet code requirements will continue.

Products: Ninety of the most critical of approximately 1000 large engine generators will be modified, refurbished, or replaced as required to maintain availability and quality of standby power service.

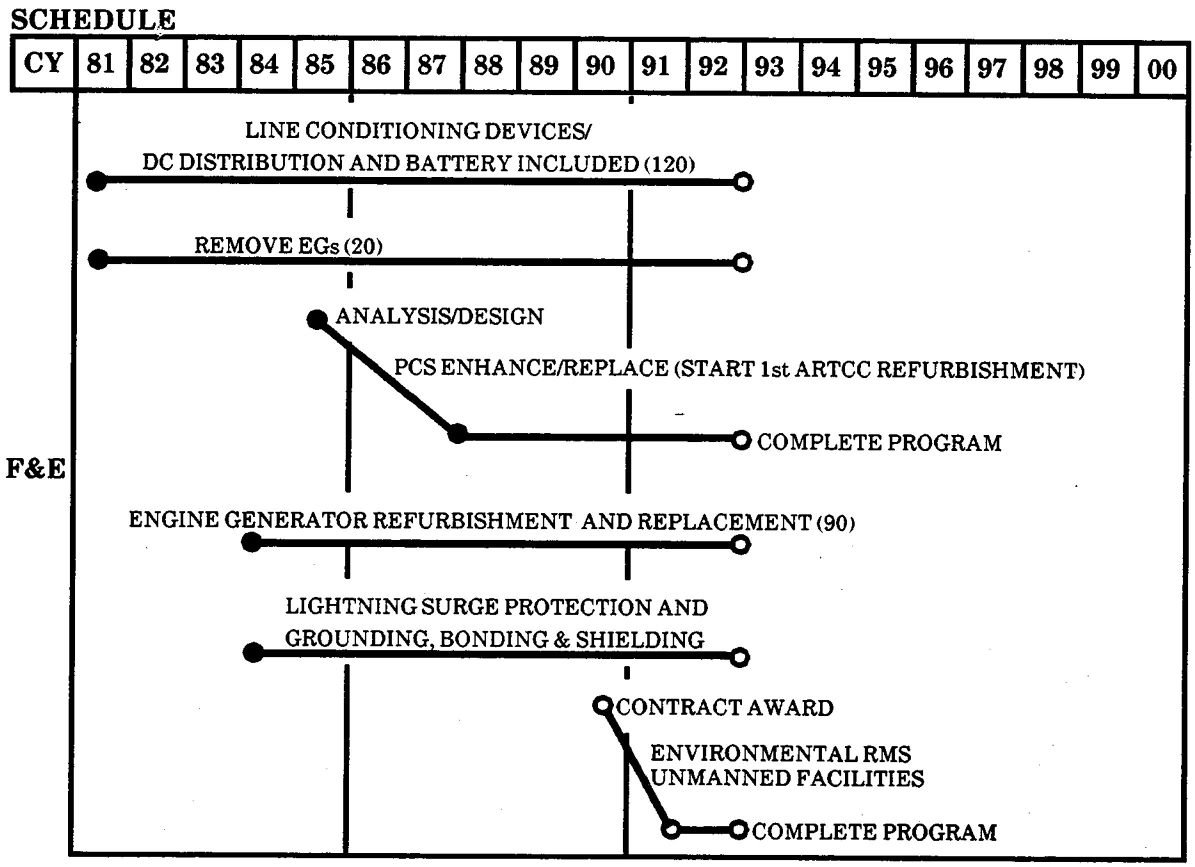
Approximately 120 line conditioning devices (battery systems/power filters/motor-generators/ uninterruptible power systems/etc.) will be provided, where required, to compensate for poor quality or reliability of available utility services.

of these facility electrical system modernizations will be required at large-scale facilities such as ARTCCs, ATCTs, ARSRs, and ASRs.

A new critical power system incorporating an Uninterruptible Power System (UPS) will be provided for the future ACFs.

Related Projects/Activities: This project and the fuel storage tank effort described in Chapter VII are designed to resolve the immediate engine generator Unmanned FAA Airway Facilities Buildings and Plant Equipment. Close coordination and common approach is also required with the ARTCC modernization program. Cost avoidance and minimized impact on the ongoing operation are the benefits.

Accomplishment of remote maintenance monitoring equipment installation concurrently will also be beneficial. Communication facility consolidation program may alter schedule and requirements, as may the final ACF configuration decision.



individual contracts managed by the region. The work has been accomplished on an as-needed basis dependent on manpower and funding availability.

The large number of buildings approaching the end of their normal service life (generally 20 to 30 years) has created a need for a national program. It is quite probable that it will be more economical to replace some older buildings than to modernize them.

Approach: The practice of performing modifications according to the needs of the moment and tailoring these modifications to the requirements (climate, existing equipment mixes) reduces the degree of standardization between facilities. A systems approach will provide improved standardization and decreased support costs. A comprehensive national plan will be developed to provide new standards and implement modernization and improvement projects.

Many existing unmanned Airway Facilities buildings will continue to be used for the next 20 years. Much of the original electronic equipment installed in these buildings has been or will be replaced with a newer generation of equipment with environmental, size, and maintenance requirements that are substantially reduced. Appropriate modification will be made to adapt these facilities to the new equipment requirements and, thereby, reduce operational costs.

communications, ARSR 4, etc.

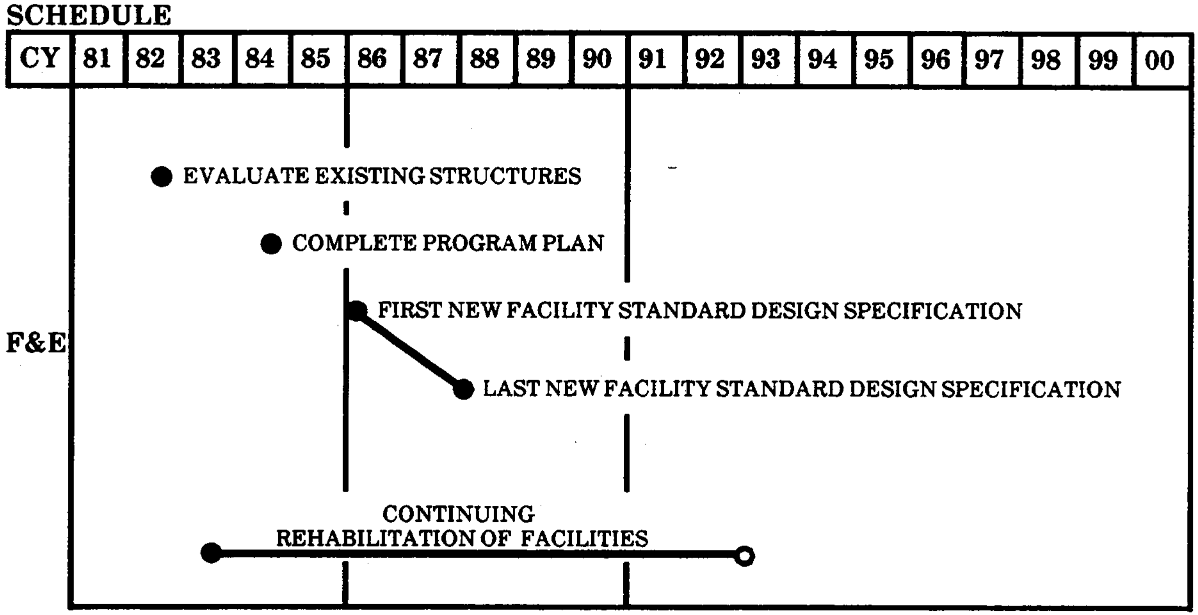
Tramways will be considered for dependable access to mountaintop ARSRs when economically justifiable and operationally advantageous.

Products:

- Standard facility designs will be provided.
- Approximately 150 separate improvements at 60 facilities each year are planned through FY 89.
- The program has been expanded. Beginning in FY 90, approximately 2,400 separate improvements are planned to be made at 1,000 facilities per year.

Related Projects/Activities: Mechanical and facility modernization work described herein will be completed in consonance with electrical and environmental control system work described in the Power Systems project. Support will also be provided to other radar, communication and NAVAID programs. Communication facilities consolidation, and ACF program final configuration decision, may alter the schedule or requirements. Continuing efforts beyond 1992 will be provided by the Sustained National Airspace System Support project in Chapter VII.

SCHEDULE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EVALUATE EXISTING STRUCTURES
COMPLETE PROGRAM PLAN
FIRST NEW FACILITY STANDARD DESIGN SPECIFICATION
LAST NEW FACILITY STANDARD DESIGN SPECIFICATION
CONTINUING
REHABILITATION OF FACILITIES

Approach: Modernization designs and site adaptation will be provided by the Systems Engineering and Integration Contractor. Site unique designs and construction will be by regional contracts. Construction in en route centers specifically required for the implementation of the host computer and the advanced automation system will be funded under the advanced automation program and other ACF related programs.

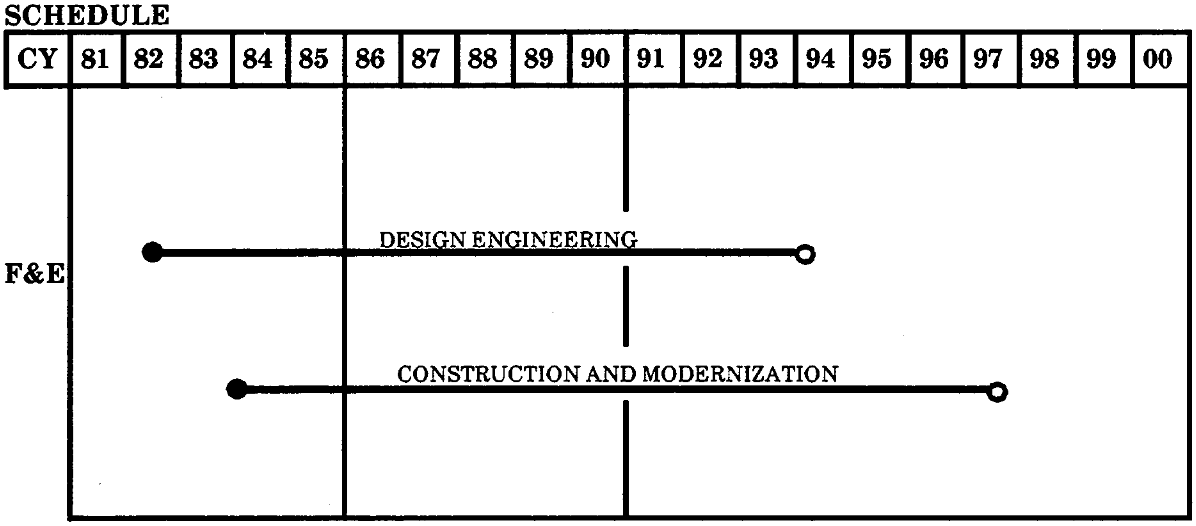
Building expansion, rehabilitation and modernization include:

- HVAC system and electrical system replacement and upgrade to include critical and essential system switchgear.
- Refurbishing of interiors, asbestos control, and OSHA compliance.
- Security enhancements.
- Energy conservation.
- Grounds, roads, and parking upgrade.
- Reroofing.
- Central Control Monitoring System replacement and upgrade.
- The remaining offshore CERAPs (San Juan and Guam) will receive appropriate upgrades.
- The New York TRACON will receive appropriate upgrades until conversion to an ACF.

Related Projects/Activities: This project will provide the environment and physical plant interfaces with the host computer and the advanced automation system. This mandates an integrated planning and engineering effort to assure the adequacy of the end product and prevent duplication of work. Scheduling and space requirements for the upgraded PCS system provided under the Power Systems project will be integrated into the overall master facility modernization plan. Structural and environmental changes will be coordinated with, and consider requirements for, the earthquake hazard reduction project activity, i.e. conformance to seismic zone requirements and codes.

Additional plant modernization needs beyond 1992 will be provided for in the sustained NAS Support project in Chapter VII.

SCHEDULE



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DESIGN ENGINEERING
CONSTRUCTION AND MODERNIZATION

accordance with standard FAA operational and technical requirements. These 61 automated facilities will range from 8,000 to 12,000 square feet and be large enough to accommodate all personnel and equipment requirements.

Sixty sites have been selected and approximately 93% are under construction or completed.

The following factors are considered in evaluating sponsors' proposals for building facilities:

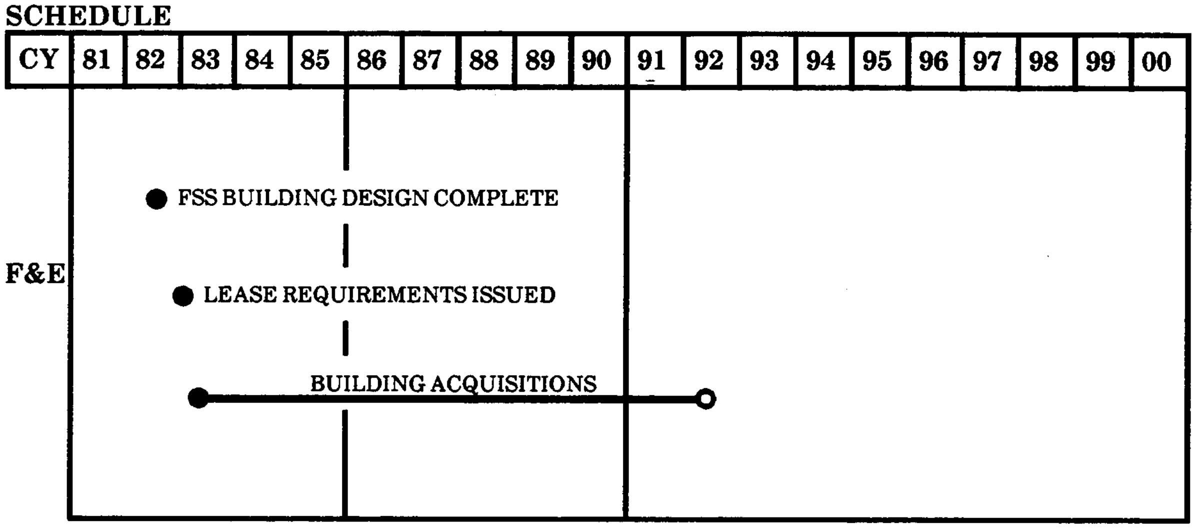
- Life-cycle cost which includes all FAA costs associated with a particular location such as one-

bility, number of employees to be relocated, availability of quality housing, number of aircraft operations, and number of based aircraft.

Products: 61 automated flight service station facilities.

Related Projects/Activities: The integrated communications switching system (ICSS) shall provide the computer-based switching and control equipment required to support FSS air-ground and ground-ground voice communications.

SCHEDULE



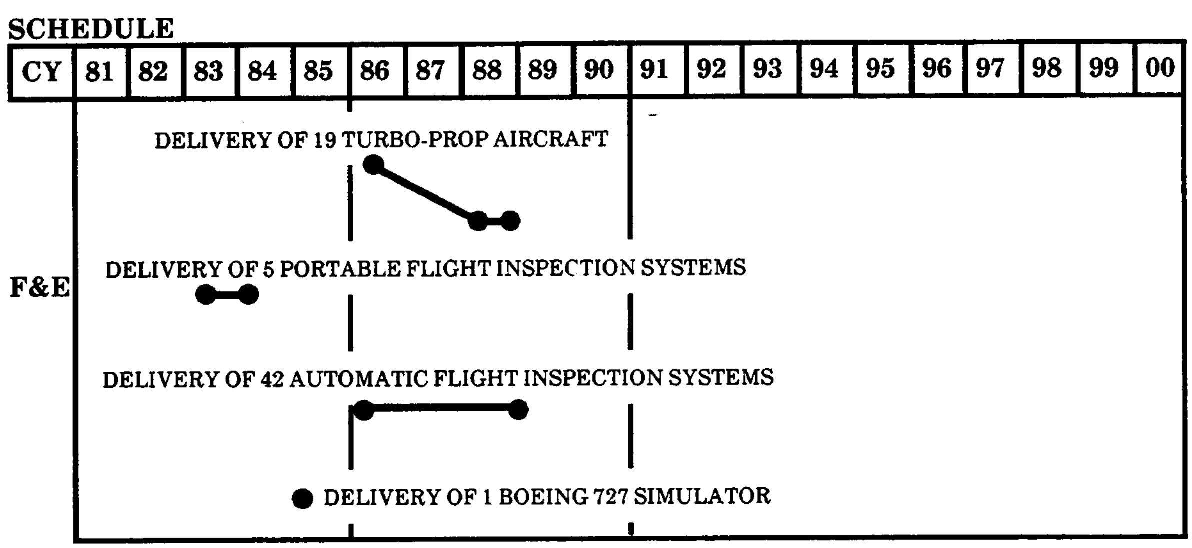
Replacement of flight inspection aircraft will result in an annual operations savings of $12 million and 2.9 million gallons of fuel. Cost avoidance of $20.2 million for major modifications will be achieved through elimination of requirements to retrofit Sabreliner engines, perform wing modifications, and service life-extension modifications.

Approach: Replace aircraft presently used to support the agency's five flight programs with fuel-efficient aircraft, employ light-weight flight inspection systems, and upgrade semiautomatic flight inspection systems to increase computer storage capacity and reduce processing time.

- <u>Flight programs.</u>
  - 1 Boeing 727 simulator.

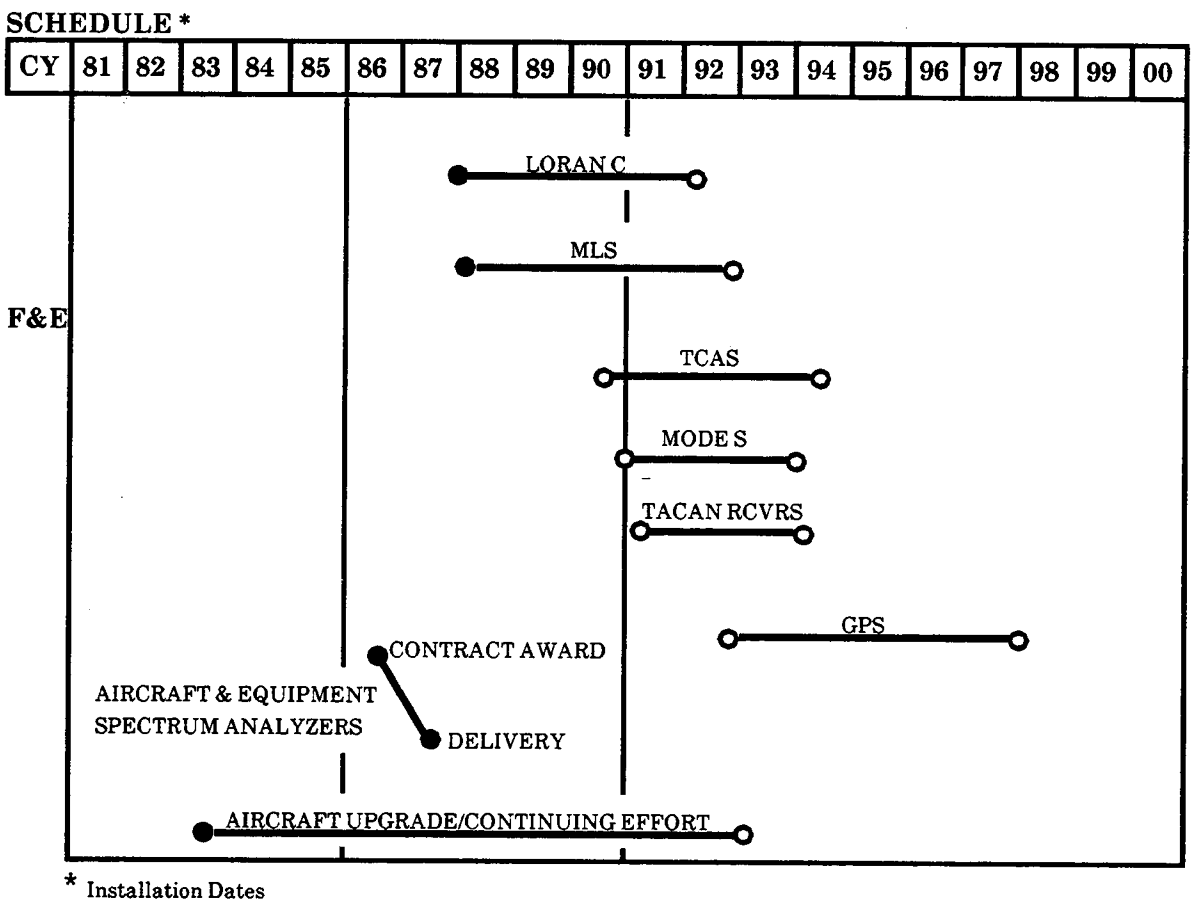
Related Projects/Activities: The aircraft and automated flight inspection systems receive support from the airborne support complex of the General Support Laboratory, but rely on the Aircraft and Related Equipment project to provide the new system avionics, such as Mode S, GPS, MLS, and LORAN C.

PROJECT COMPLETE



essential to the safety of agency aircraft and personnel.

Approach: Short and long-term initiatives have been developed which consider all requirements which affect the capability to provide fleet support. Enhancements and upgrades of the fleet to state-of-the-art configuration include procuring and installing LORAN C, MLS, MODE-S, TCAS II, GPS, Flight Management Systems, Electronic Flight Instrumentation Systems, Precision Distance Measuring Equipment, Cockpit Voice Recorders, transition of the National Airspace System is contingent on aircraft fleet capabilities for support of system design and system flight checks, validation and evaluation. GPS Monitors, MLS, Mode S, NARACS, and Loran C projects are directly related. Implementation of Project Safe and other initiatives which require aircraft support are also dependent on this project. Additional aircraft upgrade requirements beyond 1992 will be accomplished under the Sustained National Airspace System Support project in Chapter VII.



systems.

- Identify and compare alternative implementation strategies.
- Assess program impacts.
- Refine technical, cost, and schedule estimates.
- Review technical proposals.
- Evaluate alternative designs.
- Provide technical direction to subsystem contractors.
- Ensure developed items meet specified requirements.
- Integrate subsystems into the operational system.

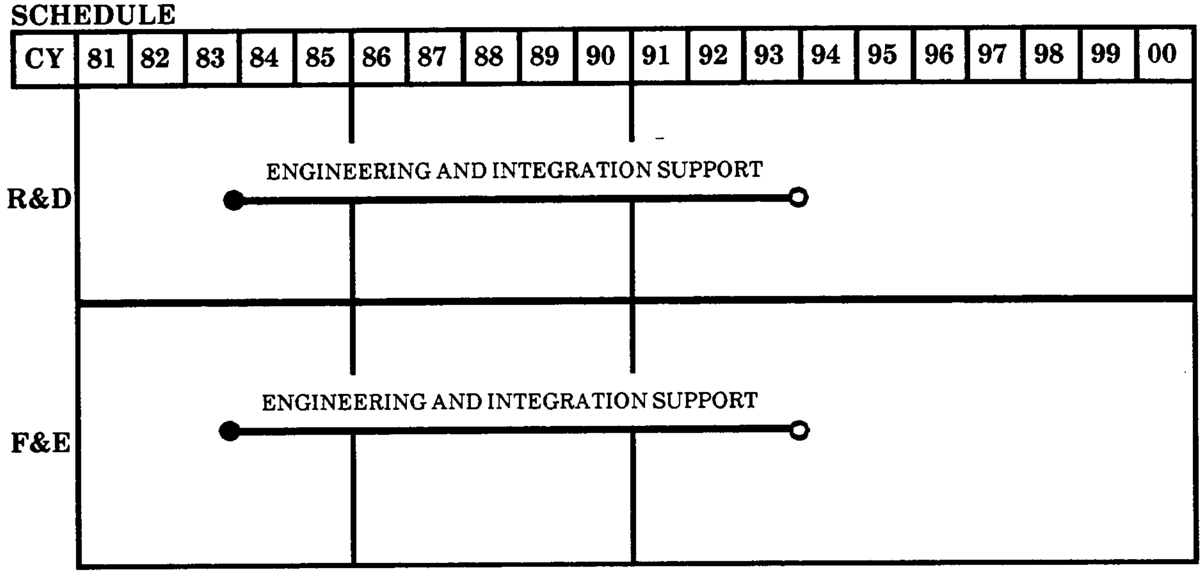
The requirement for technical expertise in the support of the large systems engineering and implementation effort cannot be met with the available FAA staff.

and trade studies, performance analysis and model, system designs, system integration plans, system implementation strategies, logistics, and training plans.

- Project management support for requirements analysis, specification development, procurement package review, proposal evaluation, contract monitoring and technical evaluation, and direction of field installation.
- Control tools and systems for benefits analysis, cost analysis, schedule analysis, risk analysis, configuration management, and program control and monitoring.

Related Projects/Activities: Most of the NAS Plan projects are supported by the system engineering and integration contract.

SCHEDULE



regions, field facilities, aircraft, and other Federal, state and local government agencies. In addition, the network will also be available for routine purposes on a daily basis for use in dispatching and redirecting Airway Facilities maintenance technicians, aviation security, accident investigations, and other NAS activities. The NARACS is based on National Security Decision Directives (NSDD-47, 97 145).

Approach: Phase I established a high-frequency/single-sideband (HF/SSB) backbone system, or control network with nodes, at FAA headquarters and at three emergency operating facilities. Seattle and Anchorage HF/SSB radio systems will be upgraded to enable them to operate as an extension of the backbone network. The backbone network will also have voice and data privacy.

Phase IA is providing upgrades and enhancements to the communications security terminal equipment operated with the automated digital network (AUTODIN).

Phase II will establish two geographical networks with HF/SSB radio communications equipment to interface with the national command/control backbone communications network. The two networks, called Eastern and Western Command Nets, will provide radio communications with the regional offices, ARTCCs, FIFOs, major airports, FAA support aircraft, and other key facilities within each area. These networks will have the capability to transmit voice and data messages in the clear or private mode. The HF portion of NARACS shall be protected from Nuclear, High-Altitude Electromagnetic Pulse (HEMP).

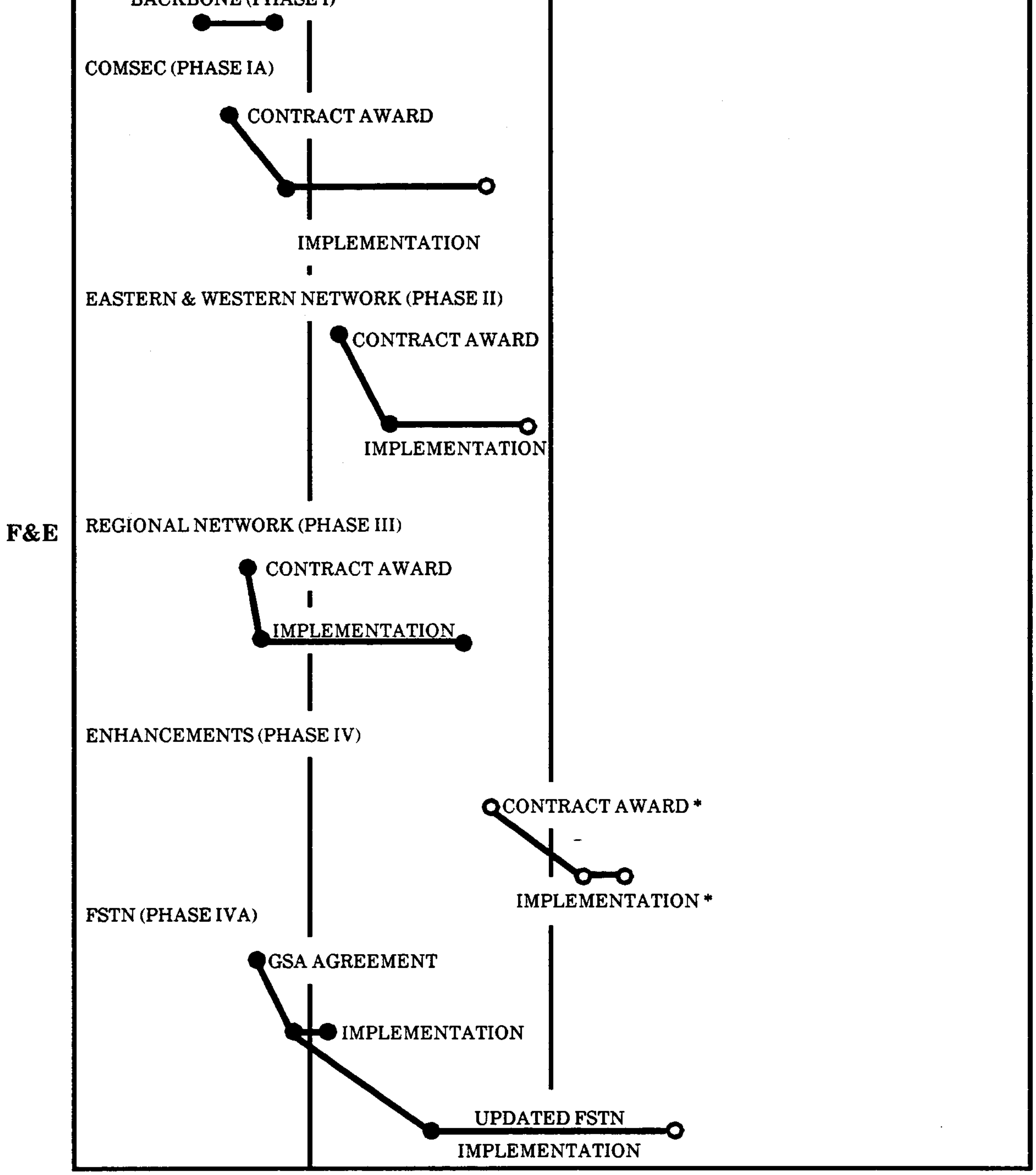
Phase III will provide highly reliable two-way radio communications, which are independent of common of transmitting messages in the unsecure voice mode or data encryption standard (DES) mode. Radio links will be installed as necessary to provide radio connectivity between regional FM and national HF networks. RCL equipment will be used to the maximum extent possible to satisfy connectivity requirements.

Phase IV will expand and enhance the HF/SSB backbone network for full-duplex, voice, and data transmission. This effort will include the establishment of remote sites at Atlanta and Denver and provide HF radio transceivers at automated flight service stations and radio links for the remote sites, including the facilities in the Washington headquarters area. In addition, Phase IV will provide a HF/SSB transportable communications capability.

Phase IVA will establish the federal secure telephone network (FSTN) at Washington headquarters, regional offices, ARTCCs, and other major field offices.

Products:

- Phase I – Communications control center, FAA headquarters, and three national emergency operations facilities (NEOF).
- Phase IA – COMSEC network upgraded to AUTODIN.
- Phase II – Eastern and western networks.
- Phase III – Regional networks.
- Phase IV – Duplex system for backbone network.
- Phase IVA – Federal secure telephone network.



* Schedule Under Review

adequate spectrum is available for each NAS Plan project requiring frequencies.

This planning effort involves electromagnetic compatibility analysis, large scale frequency assessment studies, formal spectrum certification required by National Telecommunications Information Administration (NTIA) for new systems, national and international frequency coordinations, radio propagation studies, and facility networking.

Represent the U.S. in meetings of the International Telecommunications Union (ITU) and International Civil Aviation Organization (ICAO) to protect U.S. aviation interests. These meetings develop policy, technical procedures, and criteria concerning the use, sharing, management, or allocation of the radio spectrum for the NAS as well as other aviation systems.

Obtain and protect necessary frequencies for the NAS facilities through automated computer techniques to the extent possible. Investigate and resolve radio frequency interference (RFI) problems. High-power AM, FM, and TV stations are serious interference sources to both ground and avionic equipment. Resolution and prevention of this type of interference involves close coordination with the broadcasting industry, FCC, and ICAO.

Investigate and conduct field measurements of potential personnel radiation hazards to ensure all AFTN, world area forecast system, etc.).

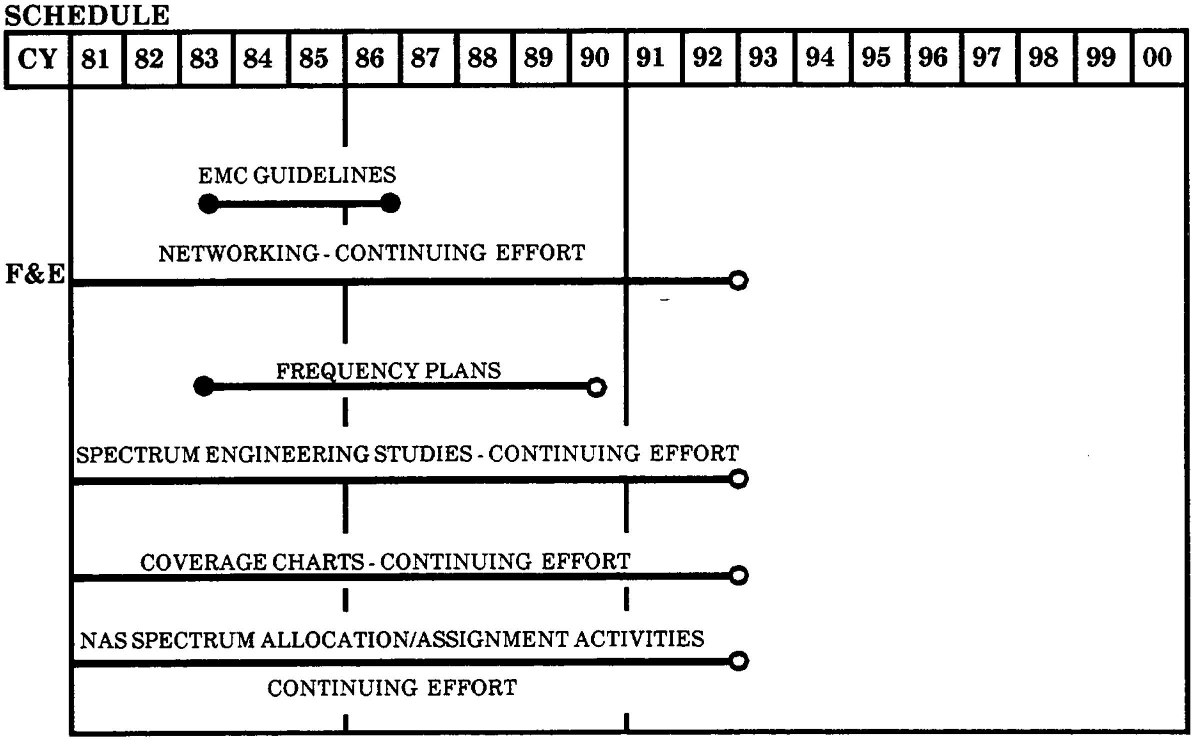
Products:

- Frequency plans in support of the NAS Plan include MLS, high-altitude EFAS, 25 kHz air-ground communications, RCL, NARACS, and, NEXRAD.
- EMC guidelines for facility consolidation.
- Frequency authorization and formal spectrum approval from the National Telecommunications and Information Administration.
- Facility coverage charts.
- Spectrum engineering studies in support of the NAS plan. These studies include frequency engineering models, RFI suppression devices, investigation of state-of-the-art technology and procedures for RFI elimination, AM/FM/TV interference evaluation, etc.

Related Projects/Activities:

- Spectrum engineering facilities and activities at the FAA Technical Center provide the test bed and electromagnetic compatibility analysis necessary to accomplish the spectrum management function.

SCHEDULE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F&E
EMC GUIDELINES
NETWORKING - CONTINUING EFFORT
FREQUENCY PLANS
SPECTRUM ENGINEERING STUDIES - CONTINUING EFFORT
COVERAGE CHARTS - CONTINUING EFFORT
NAS SPECTRUM ALLOCATION/ASSIGNMENT ACTIVITIES
CONTINUING EFFORT

analysis system; universal printed circuit board testers for installation at planned consolidated maintenance facilities; explosive detection systems; mechanized warehouse storage/ retrieval system; automated logistics and inventory system (LIS), including on-line field requisitioning at the Aeronautical Center Depot, providing radomes at beacon-only sites; procuring calibration standards to certify test equipment; a computer-aided engineering design system at each regional office; three level weather for ARTCC displays.

Certain ongoing efforts must continue to support the National Airspace System. These include: in-house and contractual engineering, design, and analysis for quick reaction engineering and other technical assistance; minor regional and locally identified modifications, refurbishments, and equipment relocations; improvement and leasing of Technical Center plant and facilities; earthquake hazard reduction of facilities; procurement, rehabilitation or replacement of equipment for use in the engineering and development programs at the FAA Technical Center; where cost beneficial, purchasing land or acquiring protective easements for existing facilities rather than continuing to lease properties; real estate and contract management; upgrading of existing support equipment; en route hardware and software systems development and support; ATCRBS support; ARTS II MSAW topography and graphics; replacement of radomes at long range radar sites; and projects to meet Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) standards at FAA facilities.

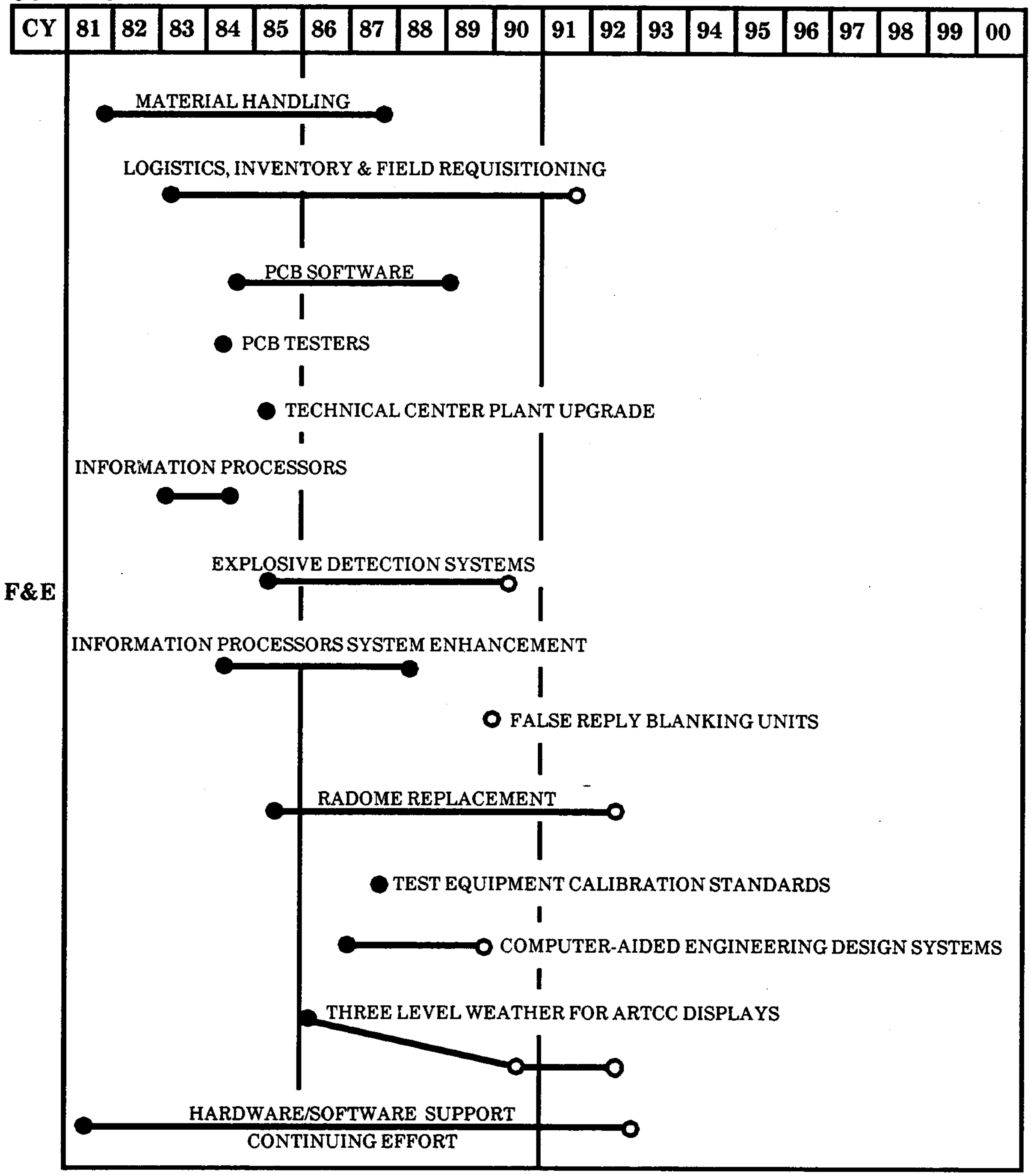
- Upgrade the FAA Technical Center plant support complex.
- Computer-aided engineering design systems.
- Test equipment calibration standards.
- Install false reply blanking units at 30 terminal beacon sites.
- Provide radomes at beacon only sites.
- Three level weather for ARTCC displays.

- <u>Ongoing projects.</u>

  - Engineering, designs, and analyses.
  - Regional and local minor projects.
  - Improvements of the plant and facilities at the FAA Technical Center.
  - FAA Technical Center building lease.
  - Purchase and leasing of land and easements.
  - Regional Logistics Contract Support.
  - OSHA and EPA improvements.
  - Printed circuit board maintenance software.
  - Radome replacement at selected sites.
  - Airports precise reference data program.
  - Leasing of space.
  - Earthquake hazards reduction.
  - ARTS II MSAW topography and graphics.
  - ARTS III Support.
  - En Route hardware and software systems support.
  - ATCRBS support.

Related Projects/Activities: This program supports ongoing F&E efforts and operations. Continuing efforts beyond 1992 will be provided by the Sustained National Airspace System Support project in Chapter VII.

SCHEDULE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LOGISTICS, INVENTORY & FIELD REQUISITIONING
PCB SOFTWARE
PCB TESTERS
TECHNICAL CENTER PLANT UPGRADE
INFORMATION PROCESSORS
EXPLOSIVE DETECTION SYSTEMS
INFORMATION PROCESSORS SYSTEM ENHANCEMENT
FALSE REPLY BLANKING UNITS
RADOME REPLACEMENT
TEST EQUIPMENT CALIBRATION STANDARDS
COMPUTER-AIDED ENGINEERING DESIGN SYSTEMS
THREE LEVEL WEATHER FOR ARTCC DISPLAYS
HARDWARE/SOFTWARE SUPPORT
CONTINUING EFFORT

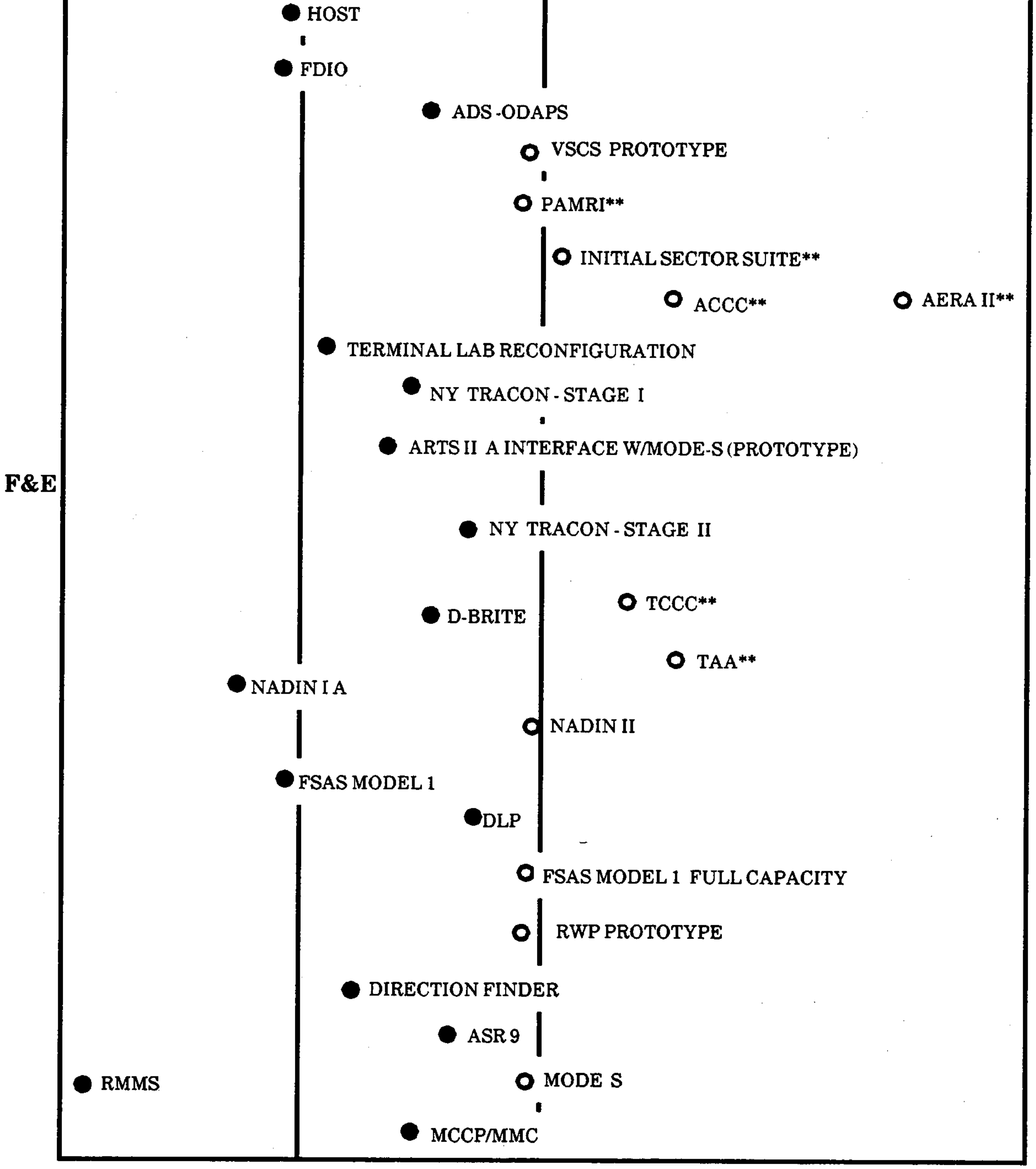
tance testing. The testing will ensure that total system requirements are met prior to installation at field facilities. Upon completion of testing, systems are integrated into the laboratory for direct field support; for development and testing of hardware, software, and firmware modifications; and for development of system enhancements.

Systems in this laboratory are configuration controlled and baselined to the level of operational field systems. Modifications are installed, tested and baselined prior to installation at field facilities. This provides a centralized maintenance and field support capability for deployed systems.

An FAA Technical Center Transition Plan has been developed and is periodically updated. The plan is consistent with the Master Transition Plan and reflective of the Master Baseline Schedule. It identifies space requirements, installation plans, and evolutionary changes that ensure the integrity of the configurations in the System Support Laboratory. System interdependencies and the switching capabilities of system configurations are also defined in the transition plan.

Products: System Support Laboratory.

Related Projects/Activities: A majority of major F&E programs. Continuing efforts beyond 1992 will be provided by the Sustained National Airspace System Support project in Chapter VII.



* INSTALLATION DATES

** PROJECT SCHEDULE UNDER REVIEW

- Airborne support.
- Simulation support.
- Test integration and control support.
- General purpose data processing support.

The support systems and projects of the above complexes are involved with design, research, development, and test and evaluation of advanced concepts, procedures, and systems that are being considered for introduction into the NAS.

Airborne support includes both fixed-wing aircraft and helicopters, which are instrumented to provide flight data for projects.

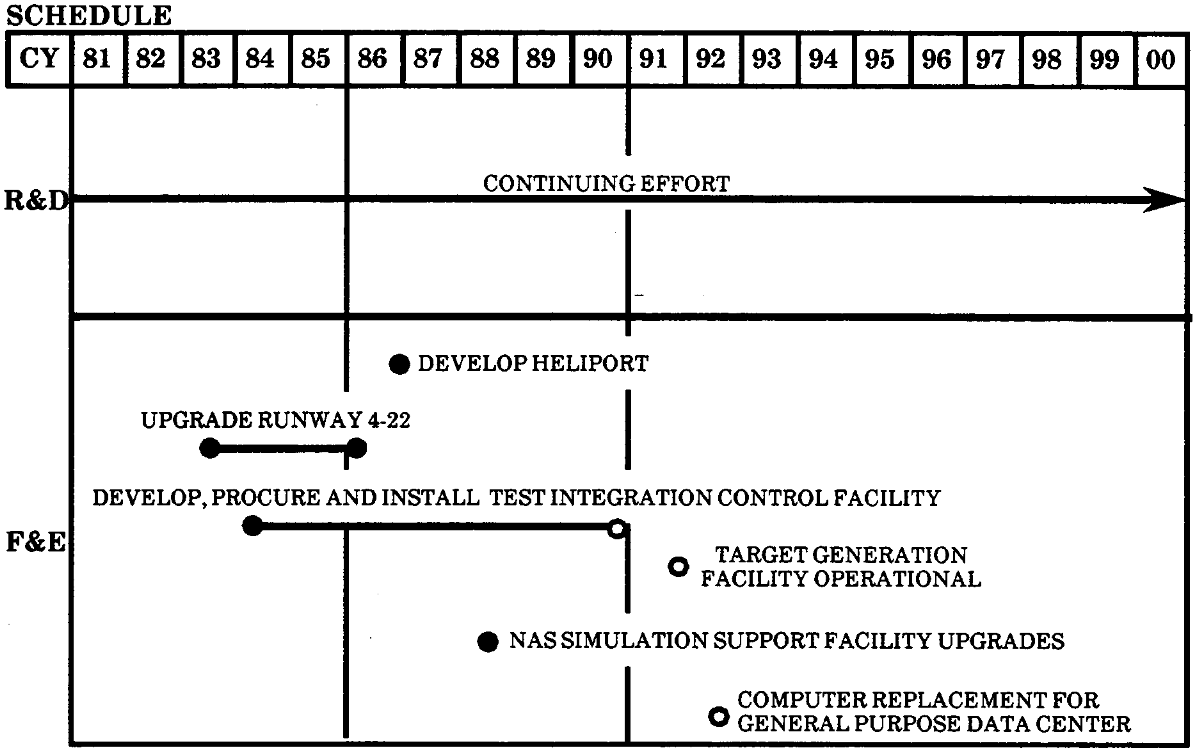
The General Purpose Data Center supports computational models as well as reduction and analysis of data obtained in tests and research.

Plans are being developed to upgrade specific complexes within the General Support Laboratory. The plans will be responsive to the requirements of the NAS F&E Plan, R,E&D Plan, and various other technical programs.

Products: An upgraded General Support Lab.

Related Projects/Activities: Many of the major F&E programs. Continuing efforts beyond 1992 will be provided by the Sustained National Airspace System Support project in Chapter VII.

SCHEDULE



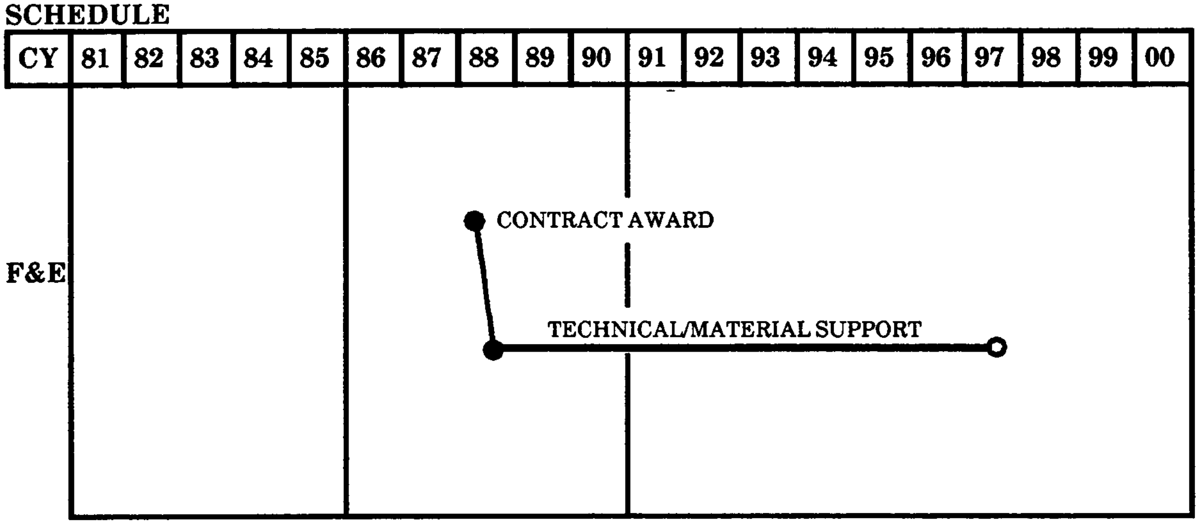
federal work force to meet these short term peak work requirements.

Approach: A national Technical Support Services Contract (TSSC) has been awarded to provide a means whereby regions and centers can obtain work force and supply augmentation required to support their facilities and engineering mission. This support involves site preparation, equipment installation and tune-up, hands-on test and equipment modifications. Work under the TSSC is initiated via a Work Release to the contractor. The Work Release may cover any portion of the "hands on" effort necessary to implement a particular project. Work Releases are issued and managed by headquarters against which Work Releases are written are made on an annual basis. An annual establishment engineer ing planning cycle is used to identify regional and national TSSC work, and to assess total F&E field support needs and establish priorities for TSSC work. Funding to support the projects in the annual contract modification is provided by the individual programs which utilize TSSC services.

Products: Support services and materials to assist regions and centers in completing NAS improvement implementation.

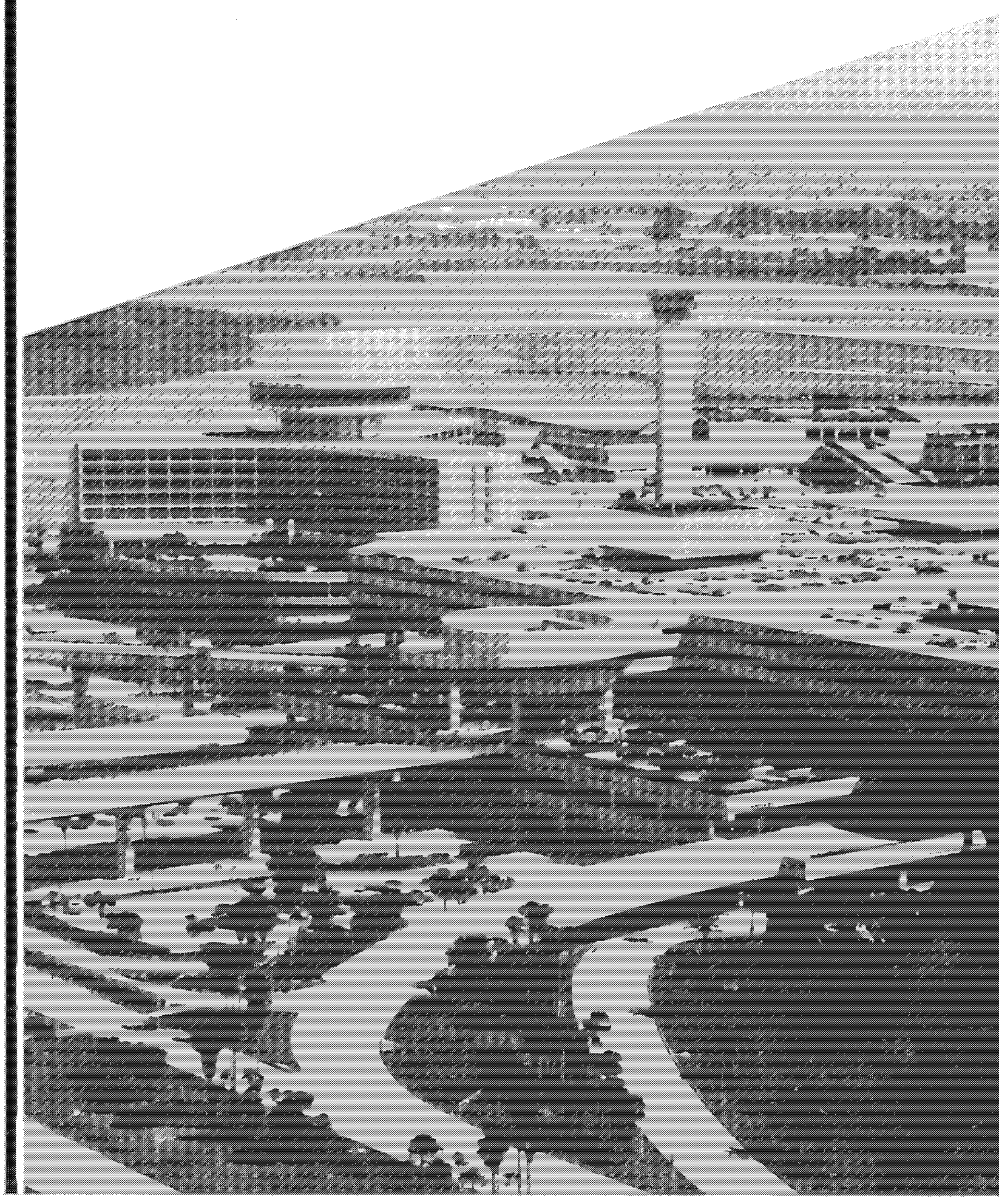
Related Projects/Activities: Potential support to any F&E project.

SCHEDULE



CHAPTER VII

OTHER CAPITAL NEEDS



OTHER CAPITAL NEEDS

INTRODUCTION

As the implementation of the NAS Plan progresses, other capital needs have and will become apparent. Prior revisions of the NAS Plan have accommodated new initiatives, such as the use of LORAN C for non-precision approaches and expanded mid-continent navigational coverage, and replacement of the air traffic control computers used at the New York TRACON. Near term, additional opportunities exist to functionally improve the air traffic control system, avoid costs associated with NAS operation and maintenance, and satisfy a variety of NAS administrative needs.

Long-term, there will be sustained aviation growth, the need for improved services at an affordable cost, and the need to accommodate a greater variety of vehicles, e.g., subsonic, supersonic, and hypersonic vehicles foreseen by the White House Office of Science and Technology Policy. These needs will cause the NAS to continue to evolve. Evolution of the NAS will occur through integration of developments obtained from research and the exploitation of new technology, enhancements of NAS Plan provided capabilities, and extension of near-term modernization initiatives.

RESEARCH AND TECHNOLOGY INITIATIVES

FAA and other aeronautical research and technology initiatives are underway today. FAA Research, Engineering and Development (R, E & D) is focused on improving safety and security, increasing airspace and airport capacity, reducing airborne and ground delays, improving services derived from NAS Plan acquired equipments and facilities, and extending ATC services to classes of aviation users who operate or wish to operate in more airspace--oceanic, low-altitude, offshore, remote areas, and high altitude. The FAA Plan for R, E & D describes activities related to the potential use of new technology, such as satellites for air-ground communication, navigation, and surveillance.

THE NAS PLAN

The improvements implemented by the NAS Plan will enhance the reliability and availability of NAS facilities and services. The Plan provides additional equipment for new qualifying locations in response to growth in aviation activity. The Plan also provides for facility consolidation and equipment modernization to reduce FAA operations and maintenance manpower requirements, as well as for controller automation aids to further enhance agency productivity. Equally important, the NAS Plan provides for a number of enhancements that will improve capacity, user productivity, and safety.

Through the advanced automation system (AAS), the ATC process will become far more flexible and more automatic than it is today. In addition, information available on weather and winds will be improved and information flow will be enhanced through the use of digital data link communications. There will be a great deal more strategic planning in traffic flow management than exists today, and the system will be more capable of rapid, dynamic adaptation as situations change.

En route and terminal ATC functions will be consolidated, and new functions will be added in the AAS, to be installed in Area Control Facilities. For example, new en route functions will facilitate user-preferred trajectories, and will improve safety by probing for aircraft and airspace conflicts along such trajectories. If conflicts are detected, these functions will alert controllers and provide effective resolutions that will minimize delays. At the en route-terminal interface, metering functions will organize selected en route traffic and schedule departure traffic over departure fixes into the en route traffic flows. Metering functions also will organize arriving traffic in accordance with terminal acceptance rates; if airborne delays are inevitable, they will be able to be taken in high-altitude airspace for improved fuel efficiency.

Further, Mode S will provide an air-ground digital data link capability. Initial data link service will provide weather products from existing weather data bases on request to aircraft in flight. These weather data will enhance flight safety and user productivity by providing current information for flight operation.

The microwave landing system (MLS) will provide more flexible approach paths than does the existing Instrument Landing System (ILS); it will support selectable glide slope angles, and curved and segmented approaches to runways. These features will permit instrument approaches to separate short runways by vertical take off and landing (VTOL), short take off and landing (STOL), and general aviation aircraft, and will reduce landing minima at runways where ILS performance is the limiting factor.

The Flight Service Automation System (FSAS) will enhance flight safety and user productivity by improving the quality of data bases containing flight planning information on weather, facilities status, and system delays. In addition, automated user access to these data bases will be provided via users' computer terminals.

The NAS Plan also includes a number of significant improvements to surveillance and weather data collection, analysis, and distribution. These improvements will result in enhanced flight operations and air traffic control. Two principal benefits will accrue--safer flight operations and improved user productivity through more reliable flight planning.

INTEGRATING NAS PLAN AND NEW TECHNOLOGY

Aviation growth and demand for better service requires the continued long term capital improvement of the NAS beyond that provided by the NAS Plan. The challenging decisions for future improvement will revolve around the determination of the best programmatic approach to improve safety and security, extend services, increase capacity, and reduce delays within acceptable levels of cost.

The NAS Plan provides a foundation for further improvements to meet additional future requirements. Further improvements will be achieved by a balanced program which: introduces new technologies and systems, in particular satellites; exploits future technology opportunities; enhances NAS Plan provided hardware and software; or deploys additional amounts of established NAS Plan type technology.

While the technology or technique choices may be clear, for example, ground based versus satellite surveillance, it will be difficult to decide on the appropriate mix of technology, formulate an appropriate transition strategy, and resolve the procedural interoperability and user implication of introducing advanced technology. Much may be gained through long-term change but much is at risk. The promise of introducing advanced technology will be carefully weighed against its associated risks and the necessity of ensuring the continuous existence of a safe, operational NAS. Safe operation of the NAS will be the major consideration in future evolution of the system. No change to the NAS will be permitted which reduces safety.

SUMMARY OF OTHER CAPITAL NEEDS

The evolution of the NAS Plan to provide safe and efficient use of the nation's airspace has now progressed for 7 full years. During this period, integration of projects into the NAS has highlighted additional opportunities for improved management and administration, cost avoidance, and NAS functional improvements. The continuing review process has also forced consideration of anticipated future demands and has fostered extensions of the original 1982-1992 NAS Plan. Introduction of new technologies and enhancements will continue the process of cost-beneficial modernization and replacement of aging systems in the years beyond 1992.

This chapter, describing other capital needs of the National Airspace System, has been catalogued both chronologically and functionally. The nearer term (pre-1992) projects will be implemented as a complement to the original NAS Plan. The longer term (post-1992) projects are intended for implementation of advanced technology, using the original NAS Plan as the foundation for enhancements and exploiting future technology opportunities.

ADMINISTRATIVE NEEDS (PRE-1992)

NAS software en route automation support, which has in the past been provided in-house, is now being accomplished by contractor personnel, thus permitting the air traffic control personnel to return to more critical and direct performance duties.

Contractually procured administrative data processing (ADP) services will provide a standard, agency-wide administrative resource to fulfill the total facilities management requirements of the headquarters, regions, and centers in a cost effective manner.

The Mike Monroney Aeronautical Center is leased from the Oklahoma City Airport Trust. This project will fund the lease of the facility and land.

The current labor-intensive process of updating, storage, and data retrieval of technical documentation will be automated. This enhanced process will significantly improve workforce utilization and productivity.

Administrative procedures will be standardized and fully integrated to provide improved information flow between organizations for administrative and project data flow. This capability supports the DOT Office of Automation Technology and Services (OATS) concept.

ATC SYSTEM FUNCTIONAL IMPROVEMENTS (PRE-1992)

An enhancement to the basic ODAPS, Automatic Dependent Surveillance (ADS), will provide frequent, automatic updates of aircraft positions on oceanic routes. ADS will furnish direct, two-way pilot-controller communications, and will include additional system functions as determined from an operational evolution of ODAPS.

Supplemental Category I and Category II ILS systems will be provided to enhance system safety.

The expansion of the en route flight advisory service (EFAS) will provide additional communications channels for coverage to 18,000 feet and above, for dissemination of en route weather and pilot report information.

Radio frequency (rf) interference is becoming more severe as the rf spectrum becomes more crowded and facilities are consolidated. This project will provide updated equipment to solve these problems and meet rf spectrum requirements.

The majority of emergency backup communications equipment now in use in ATCT and TRACON facilities is obsolete and experiencing logistics and RFI problems. This equipment will be replaced with state-of-the-art VHF and UHF transceivers.

COST AVOIDANCE OPPORTUNITIES (PRE-1992)

The FAA and the DOD will jointly fund a project to replace existing high-power requirement, mechanically rotated TACAN antennas with solid state equipment. This will reduce power requirements, permit removal of engine generators and associated fuel storage tanks, and provide more reliable and available TACAN systems.

Reliable interfacility communications will continue to be the foundation of a safe national airspace system. The commitment to continue to reduce dependence upon high-cost leased communications systems will continue to be pursued through additional procurements to improve service and reduce costs.

Computer based instruction (CBI) has proven to be a particularly cost effective and efficient method to meet FAA training requirements. Expansion and upgrade of the current CBI will provide an agency-wide system to provide training for personnel at all Air Traffic, Airway Facilities, and Flight Standards field locations.

The federal government has agreed to participate with local, state, and county authorities to identify and inspect for leakage, cleanup as required, and monitor all underground fuel storage tanks. The FAA is vigorously supporting this effort to reduce the present and potential environmental pollution.

NAS PLAN EXTENSIONS (POST-1992)

Terminal radar surveillance capability will be upgraded and expanded to provide the digitized sensor data required by the ACF and to provide service at newly qualifying facilities. Options will be provided to fill gaps in existing coverage and to provide mobile capability.

Continuing support is required to sustain the NAS equipment and facilities due to changes in operational requirements and environments or changes in airport or air traffic demands. This project will provide that support to national programs and regionally sponsored and managed projects to maintain NAS facilities and equipment.

ATC SYSTEM FUNCTIONAL IMPROVEMENTS (POST-1992)

Data link system capacity will be expanded to support the higher transaction rates and support a greater number of Mode S data link equipped users. Additional data link services will be accommodated including weather radar graphics, filing of pilot reports, notice to airmen (NOTAM) data, delivery of aviation route forecasts, and ground initiated hazardous conditions message transmission to affected aircraft.

Airport surface detection equipment (ASDE) provides reliable ground surveillance of aircraft and airport service vehicles. ASDE has positive safety implications during periods of low visibility and high surface traffic conditions. More airports will qualify for these systems in the future.

The parallel and converging runway monitors will provide increased accuracy and position update rates for aircraft making simultaneous approaches to closely spaced runways. This will permit a reduction in the required separation between aircraft on simultaneous approaches and result in an increase in the airport landing capacity.

Improvement in the tracking and display of aircraft target data will be made possible by establishing an advanced format which will provide for utilization and transmission of enhanced data from sensor sites. Integrated radar beacon trackers (IRBT), located at Mode S sites, will utilize the advanced format and provide display data in a more timely fashion. The advanced format and the IRBT will also provide improved target position accuracy, improved tracking, reduced track swapping, and capability for Mode S discrete address.

COST AVOIDANCE OPPORTUNITIES (POST-1992)

New generation runway visual range equipment will be used to replace the older, less reliable, existing equipment now serving the nation's airports.

The air traffic control radar beacon system currently in use employs several interrogator types. The existing Mode S program will replace a number of the older units; however, a large number of ATCRBS interrogators will remain in the system. Replacement of these units with additional Mode S units or monopulse systems is the preferred option for ground-based surveillance.

Based on continued use of primary radar to provide en route surveillance, it will become necessary in the FY 96 time frame to replace the older, long-range tube-type radars currently in the surveillance network.

PROJECTS PRE - 1992	IMPLEMENTATION*	
	FIRST	LAST
ADMINISTRATIVE NEEDS (PRE-1992)		
1. Data System Specialist Support	PROJECT COMPLETE	1987
2. Administrative Data Processing Facilities Management	1989	2000
3. Aeronautical Center Lease	1987	2000
4. Automated Documentation Development and Maintenance (ADDM)	1991	1993
5. NAS Management Automation Program (NASMAP)	1989	1994
ATC SYSTEM FUNCTIONAL IMPROVEMENTS (PRE-1992)		
10. Automatic Dependent Surveillance (ADS)	1991	1991
11. Supplemental Instrument Landing Systems (ILS)	1989	1993
20. High-Altitude En Route Flight Advisory Service (EFAS) Expansion	1991	1993
30. Air/Ground Communication Radio Frequency Interference (RFI) Elimination	1990	1995
31. Transceiver Replacement	1992	1996
COST AVOIDANCE OPPORTUNITIES (PRE-1992)		
40. Low Power TACAN Antennas	1991	1996
50. Sustain Telecommunications Support	1988	1997
60. Computer Based Instruction (CBI) Expansion	1989	1997
61. Fuel Storage Tanks	1987	1995

*** Includes support or lease dates.**

PROJECT SUMMARY

PROJECTS POST - 1992	IMPLEMENTATION*	
	FIRST	LAST
NAS PLAN EXTENSIONS (POST-1992)		
70. Terminal Radar Digitizing, Replacement, and Establishment	1996	2000
71. Sustained National Airspace System Support	1992	1997
ATC SYSTEM FUNCTIONAL IMPROVEMENTS (POST-1992)		
80. Aeronautical Data link Enhancements	1997	1999
81. Additional ASDE Establishment	1997	1998
82. Parallel and Converging Runway Monitor (PCRM)	1993	1997
83. Integrated Radar Beacon Tracker (IRBT)	1995	1999
84. Advanced Format for Radar/Beacon Target Reports	1996	1998
COST AVOIDANCE OPPORTUNITIES (POST-1992)		
90. Runway Visual Range (RVR) Replacement and Establishment	1995	1998
91. ATCBI Replacement and Establishment	2000	2004
92. Long Range Radar Replacement and Networking	1996	2000

*** Includes support or lease dates.**

PROJECT SUMMARY CONTINUED

PROJECT 2: Administrative Data Processing Facilities Management

Purpose: This project supports the automated data processing (ADP) needs of the FAA by creating a uniform, agency-wide computing resource for operational and administrative programs. Through such a resource, the inconsistencies and capacity shortfalls of the current ADP system will be alleviated, and will be actively avoided in the future. To accomplish this, the project will secure ADP services which will provide for total facilities management and turnkey operations through contractor-provided facilities, software, and staff. The objectives of this effort are to:

- Provide timely, responsive, and economical general purpose ADP resources to satisfy programmatic needs.
- Increase productivity of FAA programs and personnel.
- Improve effectiveness of computer facilities by retaining latest technology.
- Provide uniformity of FAA data processing, facilitating systems integration and ADP standardization.
- Provide backup processing capabilities.
- Reduce frequency of procurements for ADP upgrades, reducing related expenditures.
- Foster utility-like budgeting and usage of computer resources (uniform chargeback mechanisms).
- Satisfy, in a timely manner, the information needs of the agency with regard to its mission and administrative requirements.

Approach: The approach is to view the general purpose ADP configurations in headquarters, the regions, and centers as a common resource for all FAA elements, and to quantify the current and future demand for such ADP support. Once defined and quantified, the next step is to transfer the operational and technical functions of this ADP support to the commercial arena, devoting the FAA's limited ADP staff resources to better satisfying its programmatic requirements.

The contract created to fill the void created by this transfer will furnish the FAA contractor-provided computer resources and subsequent upgrades; provide for the design and conversion of existing ADP workload to the contractor-provided ADP environment; and provide all staffing, hardware, systems software, and off-the-shelf applications software to meet the requirements for general purpose data processing for all elements (region, center, and headquarters) in a timely and economical manner.

Products: The uniform and expandable general purpose computer resources, facilities, and technical and operational services necessary to satisfy the current and future programmatic automation needs of the FAA in a timely and cost effective manner.

Related Projects/Activities: This project supports the activities of the Computer Resources Nucleus (CORN) project. It also supports the interface and data interchange requirements of the Office of Automation Technology and Services (OATS) project.

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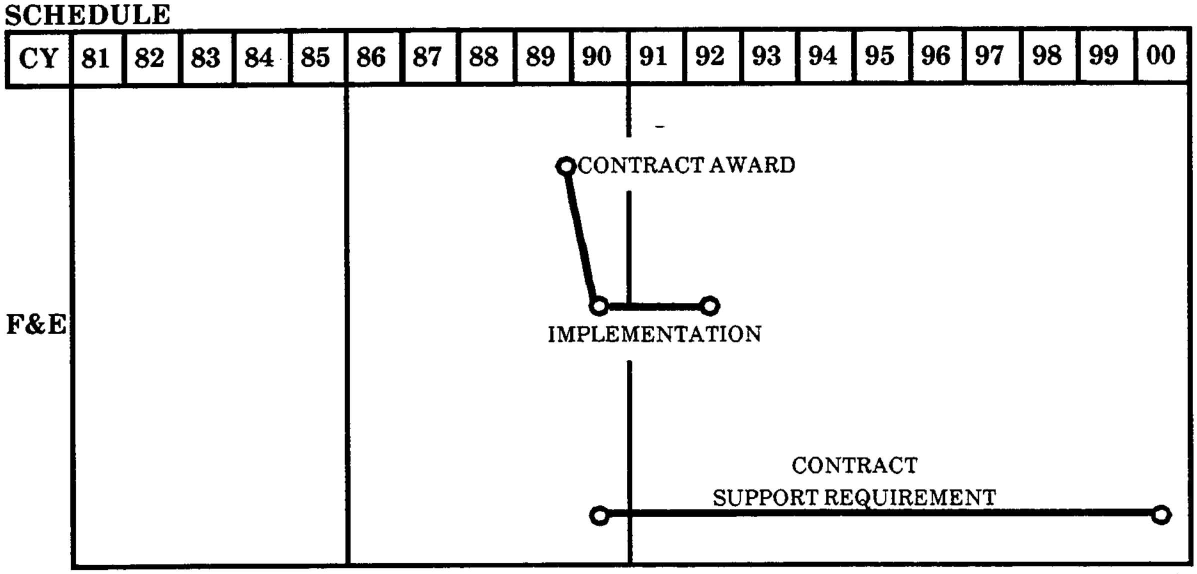
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IMPLEMENTATION
CONTRACT
SUPPORT REQUIREMENT

PROJECT 3: Aeronautical Center Lease

Purpose: This project provides for the lease payment to the Oklahoma City Airport Trust (OCAT) for the land and buildings which currently house the Mike Monroney Aeronautical Center and tenant FAA organizational elements.

Approach: The Aeronautical Center is a major organizational complex in Oklahoma City, Oklahoma. It conducts centralized training, aircraft fleet maintenance and modification, central warehousing and supply, aeromedical research, and maintains and administers aircraft and airman (including medical) records. The Aeronautical Center also provides centralized administrative automatic data processing for national programs, provides engineering support, and technical modification and maintenance field guidance for the operation and maintenance of assigned facilities in the National Airspace System.

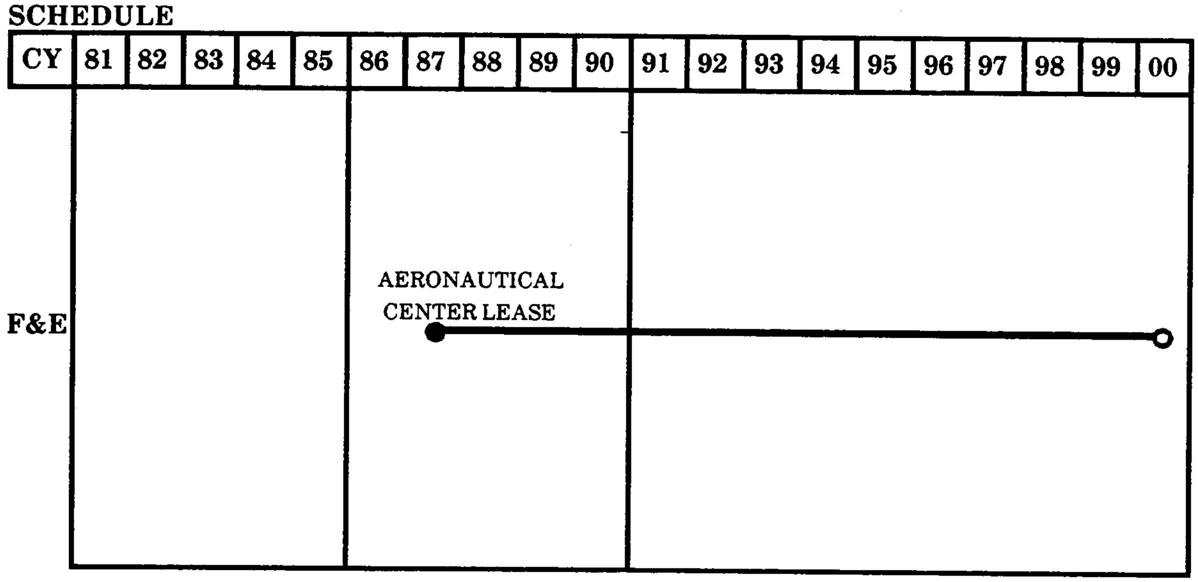
The land and buildings which house the Aeronautical Center, as well as tenant FAA organizational elements, are leased from the Oklahoma City Airport Trust, thereby providing a cost-effective, mid-continent location for the vital functions described above.

Products:

- Mike Monroney Aeronautical Center lease.

Related Projects/Activities: This program supports ongoing F&E efforts and operations.

SCHEDULE



PROJECT 4: Automated Documentation Development and Maintenance (ADDM)

Purpose: The Automated Documentation Development and Maintenance System will provide management and coordination support to the NAS modernization program.

The system will provide the foundation to develop and maintain documentation required to implement the projects identified in the the NAS Plan. The Automated Documentation Development and Maintenance System will provide tools to significantly improve workforce utilization and productivity by consolidating and streamlining numerous fragmented, labor intensive tasks.

Approach: The Automated Documentation Development and Maintenance System will consist of a two phase implementation plan. Phase I begins with a scaled down version of the full system and will be located in the Aeronautical Center (AAC), the Central Region (ACE), Central Region's four sector offices, and the Kansas City Air Route Traffic Control Center.

The AAC system will contain hardware, operating system database, and management indexing software, connected directly to the Central Region regional office. The regional stations, in addition to communication with the AAC database, will provide interface to the four sector office workstations and the Kansas City ARTCC.

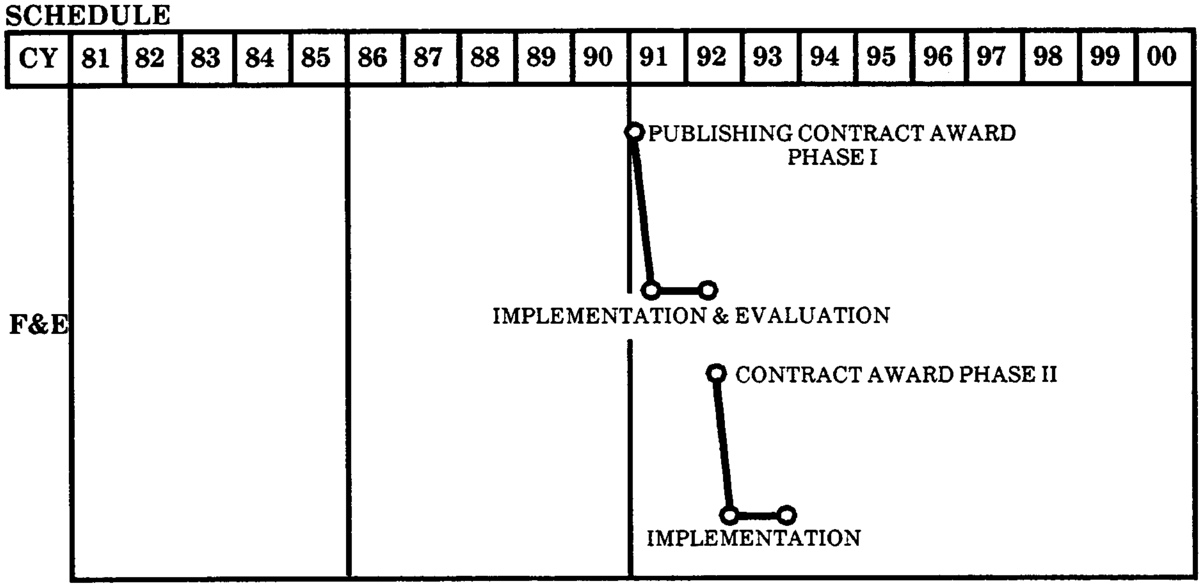
Phase II will implement the remainder of the system by adding workstations to the remaining General NAS Sectors, ARTCCs, and Regional offices, and connect the FAA Technical Center and Headquarters into the network.

The document development locations are proposed for Technical Center, Headquarters and Aeronautical Center with remote workstations at other locations as justified.

Products: The Automated Documentation Development and Maintenance System will provide an efficient automated system to produce and update documents at the Technical Center, Headquarters, and Aeronautical Center in digital format for direct transfer to an automatic storage retrieval subsystem and/or publishing. The system will provide storage of technical material in digital format, a central storage location for technical documents, and immediate network distribution. Creating a total system will provide standard, compatible exchange formats both within and outside the system, and will use minimal translations.

Related Projects/Activities: Related to the national Facilities Information System and the Maintenance Management Subsystem by sharing database information with the Automated Documentation Development and Maintenance System. This project will require interfacility communications service on the same system used by the Maintenance Management Subsystem. The Maintenance Control Center will be required to provide an interface for terminal access to the automated storage and retrieval subsystem.

SCHEDULE



PROJECT 5: NAS Management Automation Program (NASMAP)

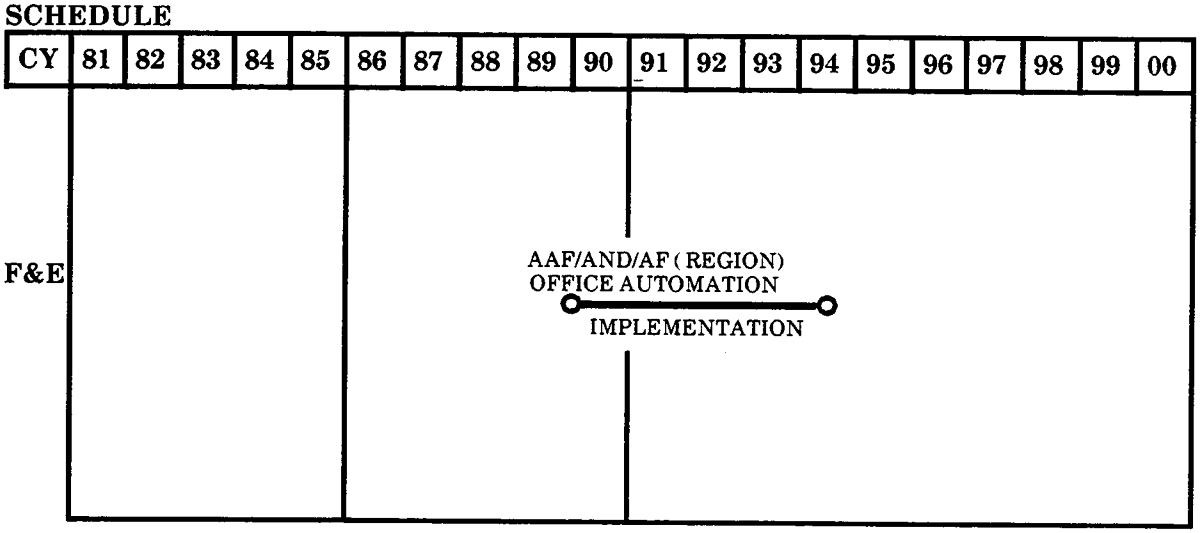
Purpose: The NAS Management Automation Program provides for the establishment of a nationwide automation capability giving FAA National Airspace Program planning and implementation organizations on-line access to application systems and databases necessary for the management and administration of the NAS Program. This will provide improved information flow necessary to meet certain requirements of the Paperwork Reduction Act and the DOT Office of Automation Technology and Services (OATS) concept. Costs and benefits are based upon workstation costs specified by the OATS program management and approved NAS organization workforce ceilings projected over the life of the program.

Approach: The program will be implemented in an incremental process. NAS organization backbone and organization/program local area network national connectivity will be established initially. NAS personnel network access via individual workstations will be provided on an organization priority basis as program funding becomes available over the period FY 90 through FY 93. Complete NAS organization connectivity is targeted for FY 94.

Products: 81 local area networks comprised of approximately 5700 microbased workstations distributed throughout NAS headquarters and field organizations. Interorganization connectivity will be accomplished via link to the FAA Administrative Data Transmission Network (ADTN).

Related Projects/Activities: This program supports ongoing F&E program planning and implementation.

SCHEDULE



PROJECT 10: Automatic Dependent Surveillance (ADS)

Purpose: This project will develop the capability to effectively utilize position information provided by the ADS system to enhance safety, efficiency, and ATC capacity in airspace presently lacking radar coverage. ADS is a function for use by air traffic services whereby aircraft automatically transmit, via data link, data derived from the onboard navigation system.

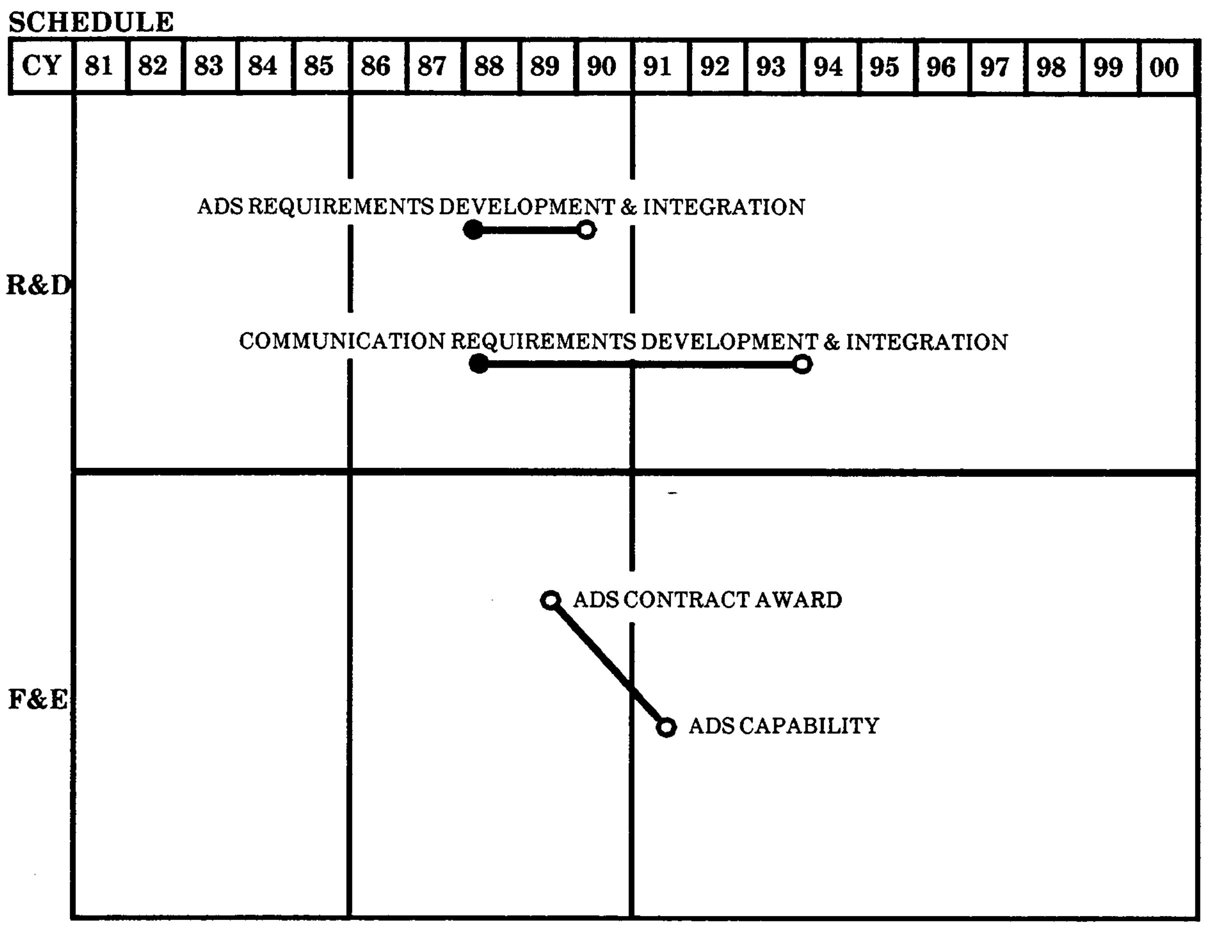
The benefits inherent in the ground ATC automation system (oceanic display and planning system (ODAPS)), in conjunction with its deviation detection and conflict probe features, will provide both greater safety and increased flexibility, and may support a reduction in separation minima in oceanic airspace.

Approach: Enhance ODAPS to process and display ADS data. Develop an ADS operational concept and system design, including the ADS requirements for avionics, air/ground satellite communication link, and the ground processing and display system. Results from the development effort will be used to support ODAPS enhancements, which will be tested at the FAA Technical Center prior to implementation at field sites.

Products: Hardware and software for two operational sites (New York and Oakland) and the FAA Technical Center.

Related Projects/Activities:

- ODAPS - The basic automation system to which ADS is added.
- AAS - The AAS will include requirements for the incorporation of ADS into oceanic automation.



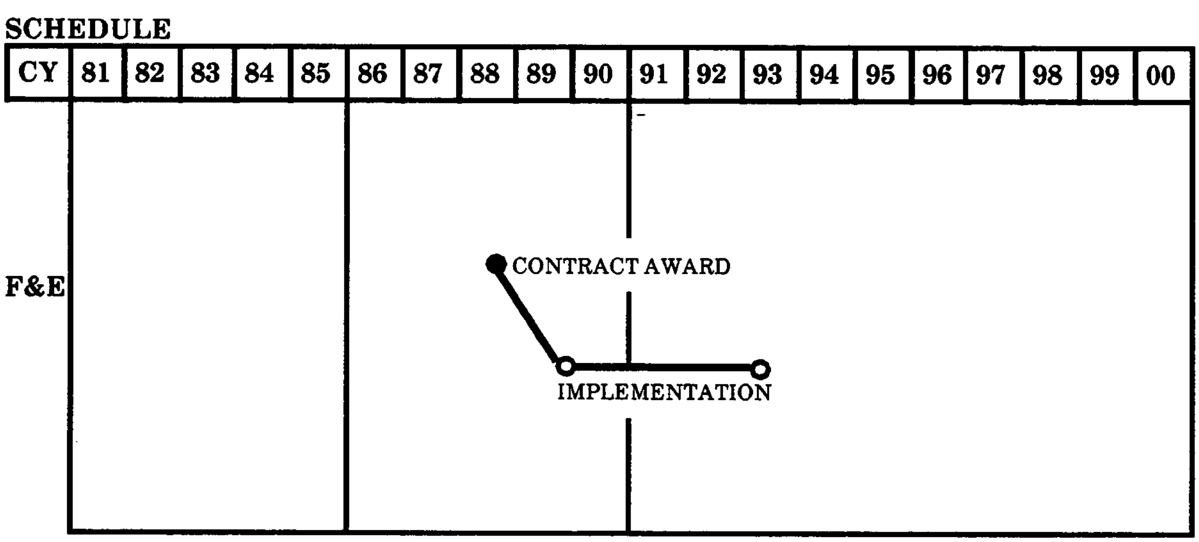
PROJECT 11: Supplemental Instrument Landing Systems (ILS)

Purpose: This project will provide for the establishment of additional Category I conventional instrument landing systems. Site locations will be established from those systems previously qualified under the Airway Planning Standards, those in other special programs such as the Commuter Airport Program, and those locations specifically designated by Congress.

Approach: New system installation will follow agency plans established for the implementation of microwave landing systems (MLS) and the continued requirements for instrument landing systems during MLS transition. New systems will have embedded RMM capability and will be implemented along with medium-intensity approach lighting system provided by the Visual Navaids project.

Products: Fifty-nine ILS establishment systems, multi year funded.

Related Projects/Activities: Project 4-06, Instrument Landing System (ILS). NAS spectrum engineering support is required to ensure interference-free operation.



PROJECT 20: High-Altitude En Route Flight Advisory Service (EFAS) Expansion

Purpose: This project will provide additional communications channels for coverage at 18,000 feet and above, for the collection and dissemination of pilot reports (PIREP) and en route weather information.

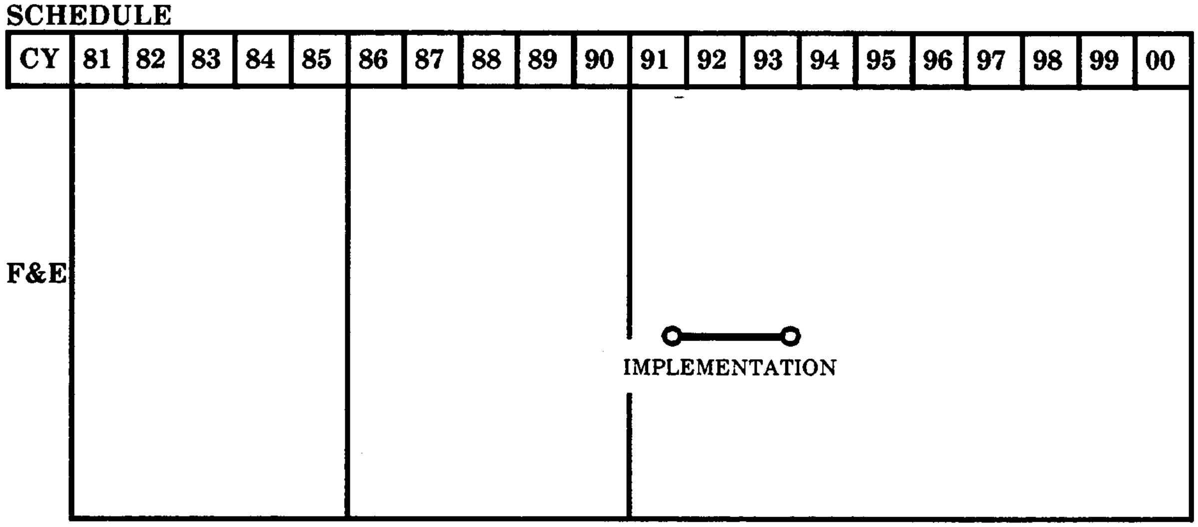
Approach: Establish discrete frequencies in addition to 122 MHz and those provided by the NAS Plan. Discrete frequencies would be protected from adjacent flight watch control station (FWCS) frequencies to reduce frequency overlap problems. Implementation for 20 flight service station (FSS) EFAS or automated flight service station (AFSS) EFAS facilities will require approximately 31 additional communications outlets, selected in accordance with plans for air-ground communications facility consolidation.

Products: An estimated 31 communications outlets, controlled from FSS EFAS locations, will be established.

Related Projects/Activities:

- Frequency and spectrum engineering will ensure that EFAS frequencies are free of interference.
- Site locations for EFAS equipment will be chosen in conjunction with communications facility consolidations.
- FSAS - As FSS consolidation proceeds, service will be provided from 20 AFSSs.

SCHEDULE



PROJECT 30: Air/Ground Communication Radio Frequency Interference (RFI) Elimination

Purpose: This project will provide selected remote communication facilities (RCFs) with modern state-of-the-art equipment, and ancillary equipment to improve operational performance in an increasingly crowded radio frequency spectrum. The existing equipment is technologically obsolete and does not meet minimum performance requirements for the congested radio frequency spectrum environment. The RCF equipment is used for transmitting and receiving analog voice between air traffic personnel and aircraft pilots using the numerous RCFs (formerly identified as RCAG, RTR, and RCO facilities). The RCF RFI solution is required to improve air/ground radio communication service.

The radio frequency (RF) spectrum is becoming more crowded as aviation grows and as air/ground radio communication antenna facilities are consolidated. An increasing concentration of air/ground radio communication frequencies in a specific geographic location requires improvements in the communications equipment and system.

These improvements will provide a reduction in intermodulation products and improved interference reduction. The existing equipment have reached the end of their 20-year life cycle. The design of the existing equipment does not meet the current RF spectrum requirements.

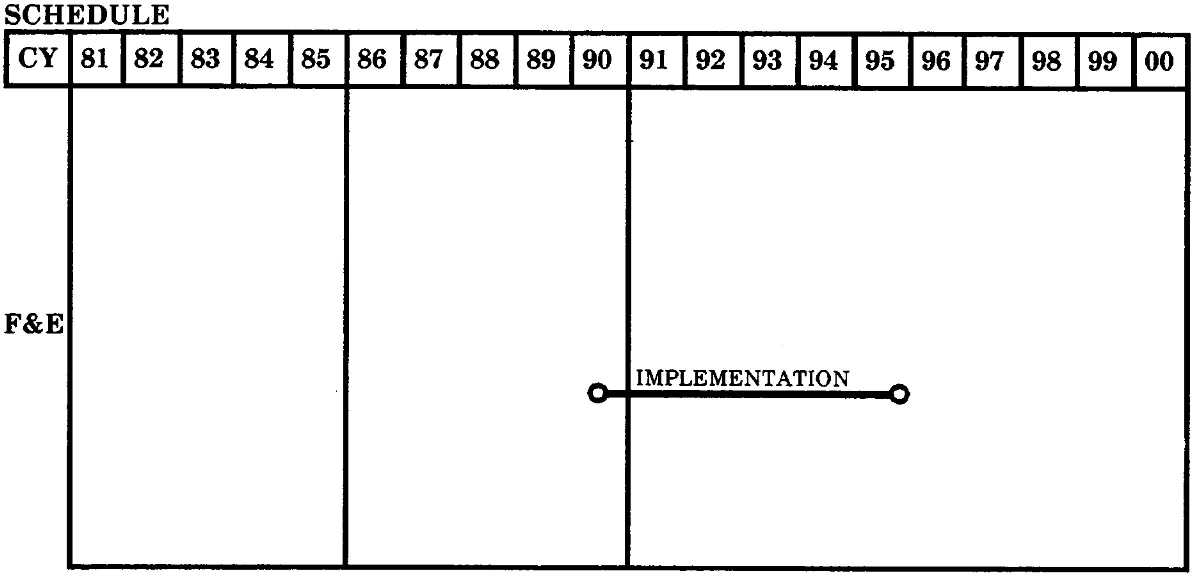
Approach: Procure state-of-the-art equipment to resolve existing RFI problems.

Products: Up to 2000 state-of-the-art receivers may be provided to resolve RFI problems at affected locations.

Ancillary devices such as antenna/multicoupler/cavity/combiner to reduce intermodulation.

Related Projects/Activities: Communication Facility Consolidation, Radio Control Equipment (RCE), and spectrum engineering.

SCHEDULE



PROJECT 31: Transceiver Replacement

Purpose: This project will provide for the replacement of aging emergency transceiver equipment in ATCT and TRACON facilities. This equipment is required in order to provide backup emergency communications capability for critical air traffic operations at these facilities. The majority of emergency equipment now in use in the ATCTs and TRACONs are tube type systems. Most of the present equipment is technologically obsolete and meets neither minimum performance standards for operation in a congested radio frequency spectrum environment, nor the criteria for Radio Frequency Interference (RFI) elimination.

The FAA is currently experiencing severe logistic support and RFI problems with existing equipment. Much of the equipment is 30 years old, was purchased prior to the implementation of the 25KHz channel spacing requirement, and is, therefore, a major contributor to the increasing number of RFI problems. The obsolete nature of the hardware, the lack of logistics support, and the preponderance of RFI problems all contribute to the urgent need to replace this equipment.

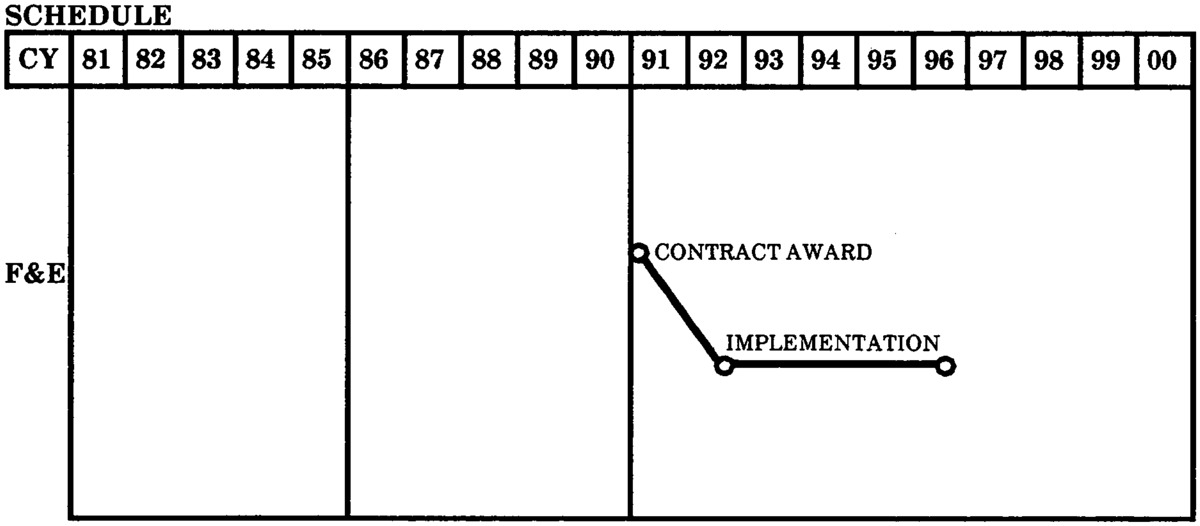
Approach: Procure state-of-the-art transceivers beginning in FY 91. Replacements will be made at Level V facilities first, followed in descending order by facility level for the remainder.

Products: A total of 3,139 state-of-the-art transceivers will be procured for installation at ATCT and TRACON facilities.

- 2,104 of these will be VHF
- 1,035 will be UHF

Related Projects/Activities: Communication Facility Consolidation, Radio Frequency Interference Elimination, NAS Spectrum Engineering.

SCHEDULE



PROJECT 40: Low Power TACAN Antennas

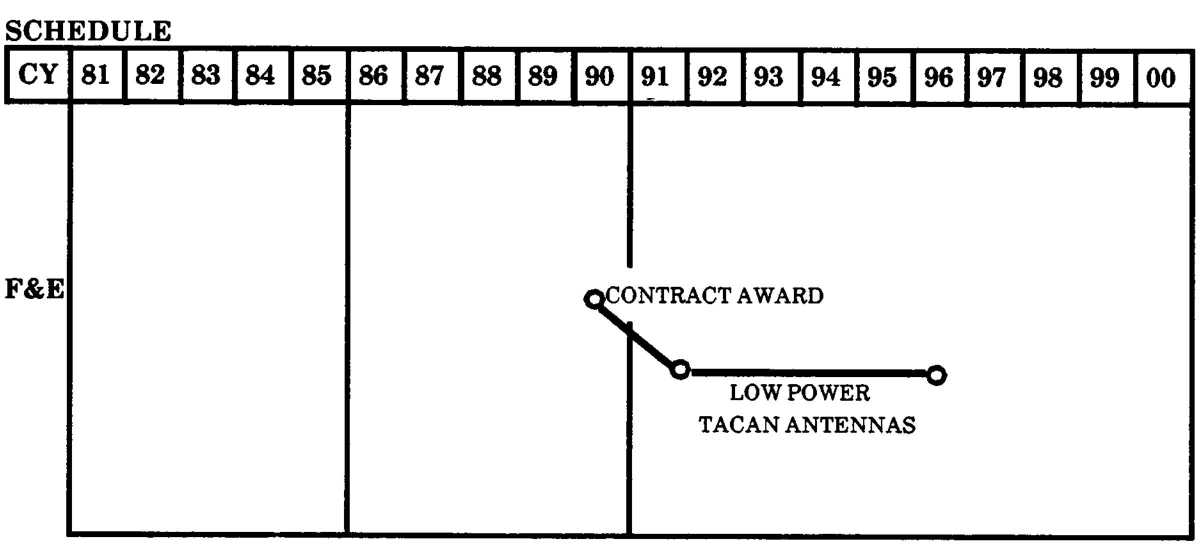
Purpose: The DOD requires tactical air navigation (TACAN) equipment for air navigation throughout the 1990s. The present TACAN antenna rotating elements are experiencing logistic support problems which compromise TACAN availability.

Replacement of obsolete antennas with low power consumption TACAN antennas will reduce primary input power requirements from 5,000 watts to 250 watts. This reduction removes the requirement for engine generated power, allows the TACAN to operate on batteries, and provides TACAN service regardless of power line interruptions. In addition, the low power TACAN antenna will be easier to maintain.

Approach: FAA and DOD will jointly fund replacement of the existing mechanical rotating TACAN antennas with new, low power TACAN antennas. DOD provided funds to acquire 62 low power TACAN antennas. Future quantities to be replaced will be based on DOD requirements.

Products: Procurement of up to 497 low power TACAN antennas is anticipated.

Related Projects/Activities: The VORTAC project is related to this activity.



PROJECT 50: Sustain Telecommunications Support

Purpose: As a strategic objective, the FAA is committed to reducing dependence on leased telecommunications in order to improve reliability, flexibility, and survivability, as well as to control and reduce costs. The FAA has pursued this objective through: NAS Plan projects that result in major FAA-owned telecommunications facilities; the implementation of FAA-owned airport telecommunications; and the acquisition of engineering services and equipment to support leased communications initiatives to improve service and save costs. This project establishes the resources necessary to provide follow-on support for these efforts to further avoid cost.

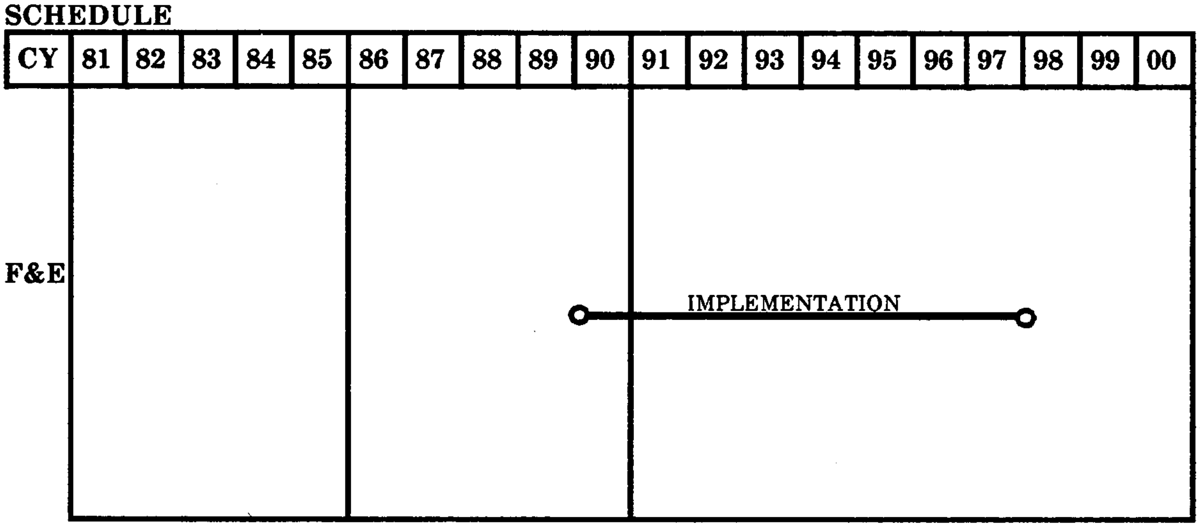
Approach: Administration telecommunications project offices and telecommunications management and operations functions identify specific sustaining telecommunications requirements and support activities. Procurements are initiated as required.

Products:

- Telecommunications Facilities Operation:
  - Software updates and enhancements
  - Hardware updates and enhancements
  - System/component reconfigurations
  - Performance upgrades
- Airport telecommunications:
  - Airport telecommunications facilities
- Leased communications initiatives:
  - Technology improvements
  - FAA ownership of embedded base equipment
  - Centralized facility circuit termination equipment

Related Projects/Activities: Related projects and activities include: RCL; NADIN IA; NADIN II; Airport Telecommunications; Data Multiplexing; all NAS systems and projects requiring telecommunications.

SCHEDULE



PROJECT 60: Computer Based Instruction (CBI) Expansion

Purpose: This project will provide for the expansion/update of the present CBI training capability, and for specialized advanced automation system (AAS) transition training for operations and maintenance personnel in all Air Traffic (AT) and Airway Facilities (AF) field locations.

CBI provides prerequisite training, and will provide national airspace system equipment introduction and overview training at AF field locations for NAS systems. Part-task simulation and trouble-shooting training will enhance Academy classroom training for new equipment/NAS training classes. CBI will continue to support a program of individually prescribed proficiency and other training in the field for AT, AF, and Flight Standards (FS) personnel.

During 1981-1985 a number of Airway Facilities courses were developed and provided at over 90 field locations. About 50% of the overall AF training requirements were met with this new technology in 1986. Additional high volume technical training is being developed for AF, AT, and FS.

Approach: CBI learning centers will be established at AF sector field offices. Existing equipment will be replaced at AF sector offices, flight inspection field offices (FIFOs), regions, centers, and the Academy to handle existing training programs and new NAS requirements. Learning centers will also be established in all AT and AF field locations where there will be a substantial requirement for high volume AAS transition training, to allow the training to occur at local work sites to the greatest extent possible. This AT and AF transition training will be developed by the AAS system contractor using government furnished equipment integrated with the FAA CBI system. This advanced automation training system (AATS) will be integrated with the FAA's ongoing CBI system to assure maximum administrative and operational efficiency, and software compatibility.

Overall, the new system will decrease dependency on real time telecommunications and mainframe software support. On-line facilities will continue to be used for student management, final testing, evaluation, updates, and record keeping. To provide the AF expanded system and improvements, a contract will be awarded in 1989 to expand/upgrade existing CBI systems, and to initiate equipment/software procurement for AT/AF training requirements associated with the advanced automation training program. Implementation will begin the latter part of 1989 for AAS, and in 1990 for the AF expansion. The initial contract will include options for additional hardware/software, and provisions for execution of these options in 1990 for additional systems to complete the entire required inventory.

Products: In 1990, 350 new terminals with hard disk drives and printers are required for sector field offices; upgrading is needed for existing terminals at AF, FIFOs, FAA Academy, Technical Center, and Headquarters.

The AAS training program will begin with the delivery of hardware and software as government furnished equipment (GFE) to the AAS contractor in 1989. Prior to AAS implementation, learning stations will be installed at all center, tower and approach control facilities, the Academy, and Technical Center. Systems will be provided to region and Academy locations for management of all training information and record keeping.

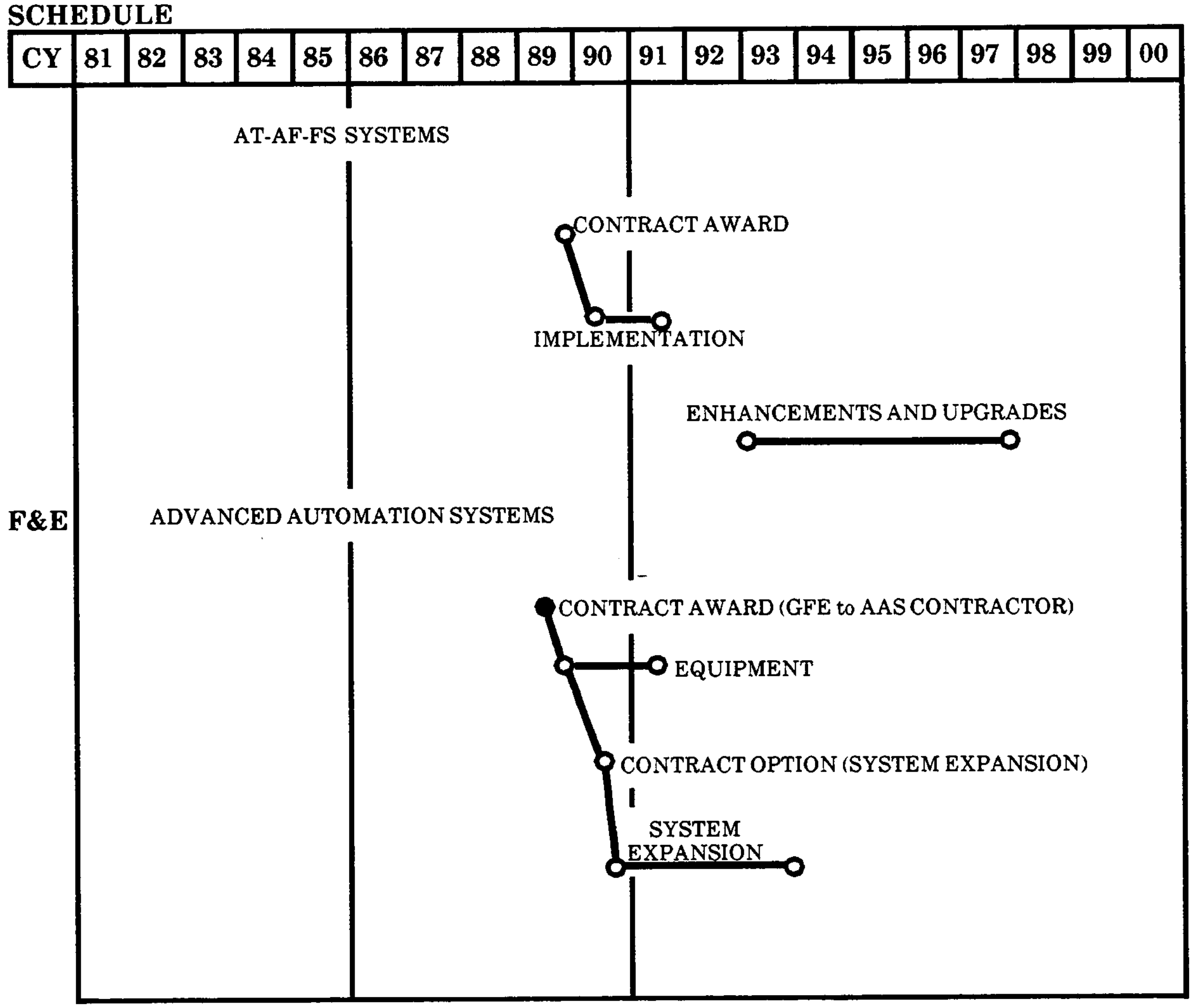
During 1990 the Air Traffic and Airway Facilities learning terminals and software support procured in 1983 will be upgraded to be compatible with the system as expanded in 1988 and 1989. New learning terminals will be provided for Level I ATCTs and in Aviation Standards facilities for airworthiness and security activities not covered in the FY 88 Project SAFE (Safety Activity Functional Evaluation) expansion.

In 1993 and 1994 the existing CBI system will be enhanced using one of a number of the enhancements available to improve simulation capability. Digital audio will permit voice recognition and voice synthesis for air traffic. Interactive optical devices, video disk and optical storage will enable greater storage and retrieval capability locally. Authoring and other software that incorporates artificial intelligence and expert system capabilities will permit the development of more realistic equipment troubleshooting and other simulations at a greatly reduced time/cost. Use of the DOT Office of Automation Technology and Services (OATS) for system/subsystem acquisition is envisioned.

In 1995-97, the system will be upgraded to keep its currency with the state-of-the-art training equipment. Current equipment will either be obsolete or in need of major revamping.

Related Projects/Activities: Chapter VI contains the baseline requirements for computer based instruction learning centers (hardware, software, and courseware), where there are concentrations of field personnel.

SCHEDULE



PROJECT 61: Fuel Storage Tanks

Purpose: The Hazardous and Solid Waste Amendments of 1984 to the Clean Water and Solid Waste Disposal Act require that owners (including the Federal Government) of underground petroleum fuel storage tanks shall: notify local (state, county, municipal) governments of such tanks; clean up sites that are leaking and replace tanks; and install leak detectors to prevent further environmental pollution.

Fuel tanks in the FAA inventory have a life expectancy of 15 years, and most of them have been in use from 10 to 25 years.

Approach: The electrical power policy directive will be changed to reflect a decreasing need for engine-generator standby power and associated fuel tanks. Engine-generators will be replaced by battery standby power at many locations. Leaking underground fuel tanks will be located and replaced or removed. The site will be cleaned up to acceptable standards. Double-walled fiberglass tanks with internal leak detectors will be installed at sites where continued use of engine-generators is required. Some small gasoline engine-generators will be converted to propane fuel with above-ground tanks. RMM compatible fuel leak detectors are required to preclude the possibility of future leaks causing either soil or water contamination.

Products: Leaking fuel tanks will be located and replaced. Either new tanks will be installed or small engine-generators will be converted to propane fuel with above-ground tanks. The affected inventory has been estimated to be 425 sites (15% of tanks over 15 years old). Batteries will also be provided where necessary.

All remaining tanks that are over 15 years old will be replaced, if they are not candidates for battery standby power. This should occur at 682 sites.

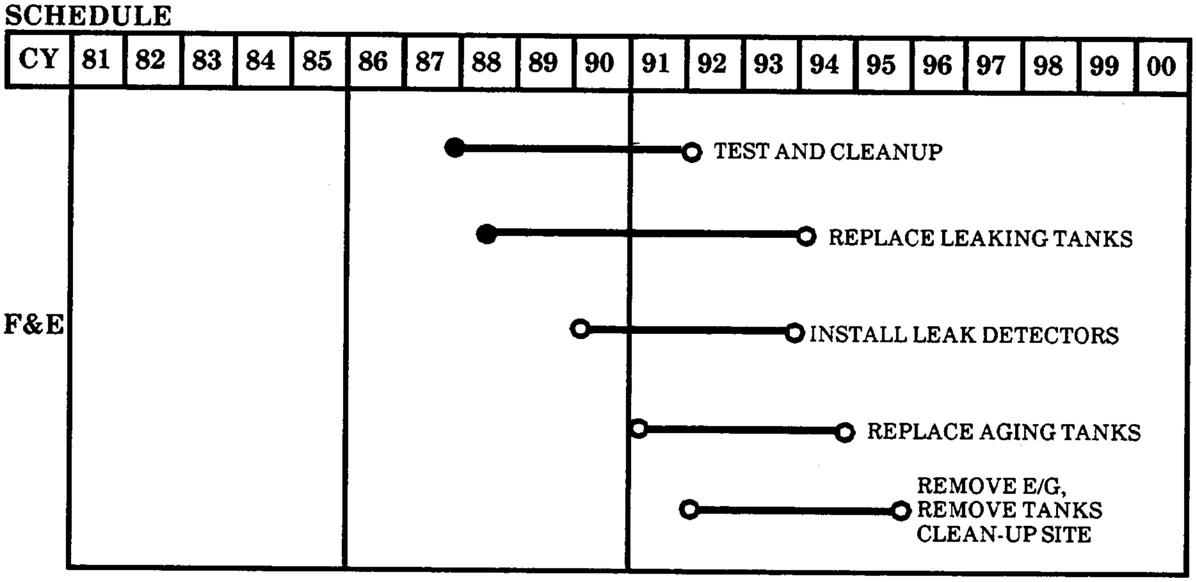
Leak detectors will be installed at sites that are candidates for battery standby power. The affected inventory has been estimated to be 2043 sites.

Leaks may develop at 15% of the sites where fuel tank replacement is deferred. This may occur at an additional 306 sites. These sites will be converted to propane fuel, with an above-ground tank to reduce the cost of the program.

Removal of tanks, site clean-up, disposal of tanks, disposal of engine-generators, and associated electrical equipment will be required at 2043 sites after conversion to battery standby power is completed.

Related Projects/Activities: RMMS and Power Systems are related projects.

SCHEDULE



PROJECT 70: Terminal Radar Digitizing, Replacement, and Establishment

Purpose: This project will provide digitized sensor data suitable for use in ACFs where the approach control function will be performed. Digitized sensor data will be provided for terminals which have existing radar approach control, for terminals expected to qualify for radar approach control by the year 2000, and for areas not presently covered by radar. This project also supports relocation of terminal radars as necessary to maintain coverage.

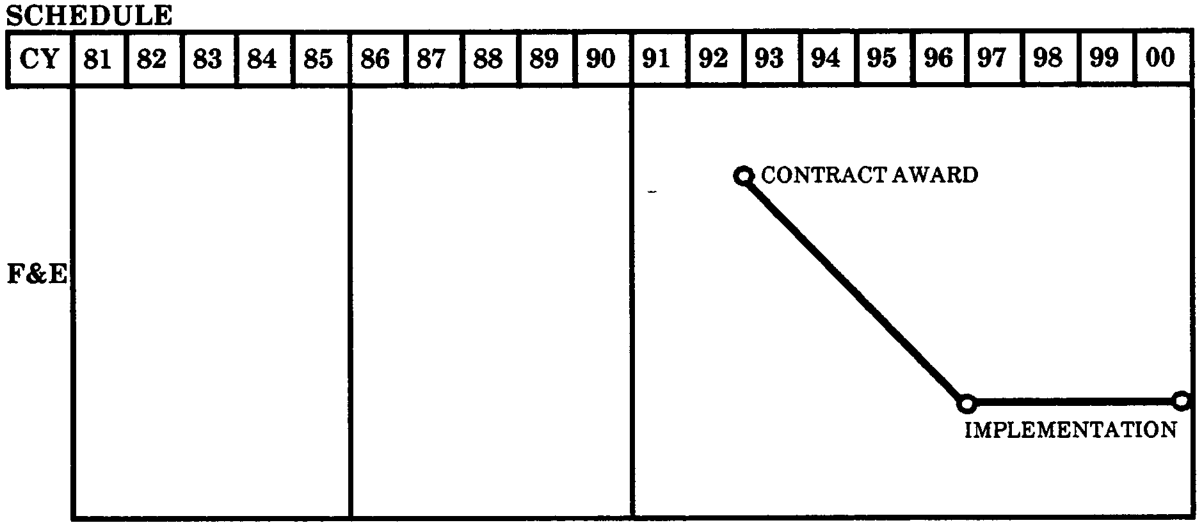
Approach: Ground-based radar and satellite equipment were considered and ground-based radar has been selected as the best solution. Consideration was also given to modification of existing equipment. This was rejected because many of these units will have exceeded their normal lifetime before implementation of such modifications, because of the poorer performance expected, and because of the greater overall long-term cost. It is expected that short-term needs for additional units will be met through the procurement of ASR 9 technology units while long-term expansion/replacement needs will be met with a new radar with post ASR 9 technology.

Products: Current plans envision:

- Terminal radars to replace ASR 7/8 radars, establish new qualifiers, provide DOD terminal control, and FAA support system.
- Terminal radars to provide gap fillers for the existing FAA and military coverage and to provide mobile facilities.

Related Projects/Activities: ASR 9 terminal radars will form the basis for definition of new terminal radars. RMMS and spectrum engineering are related projects.

SCHEDULE



PROJECT 71: Sustained National Airspace System Support

Purpose: This project provides for continued long-term investment in routine facility and equipment relocations, restorations, establishments, engineering, and improvement. It sustains, for the 1993-1997 period, actions similar in nature to generalized support obtained prior to 1993, under the auspices of a variety of NAS Plan projects.

Continuing effort is required to relocate, restore, or establish NAS equipment and facilities due to changes in the operating environment, natural catastrophe, or changes in airport/air traffic demand. Examples of required actions include relocating ATCTs if runway construction results in loss of visibility or depth perception, replacing VORs due to floods, providing visual aids to new qualifiers, and upgrading RVR capability as runways become Category II.

Rehabilitation or replacement of physical structures, facility interiors, and plant equipment will also be a continuing effort throughout the century. Such action is needed to overcome normal wear and protect past investment.

Approach: The NAS will be sustained through nationally and regionally sponsored and managed programs and projects. National programs will be undertaken to satisfy geographically dispersed needs involving the application of policy or standard designs or the acquisition of standard equipments. Regional projects will be undertaken to satisfy relatively low-cost need for modifications, refurbishments, relocations, etc.

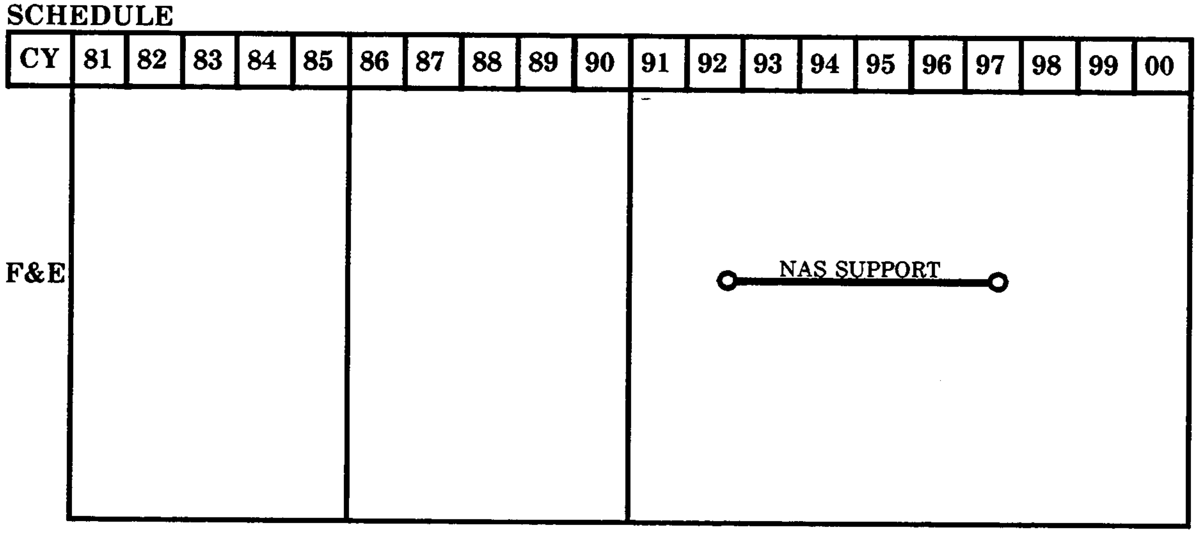
Products: Annually budgeted amounts of facility changes and equipment:

- Relocation
- Restorations
- Establishments for new qualifiers
- Engineering
- Improvement (rehabilitation, modification, refurbishment, etc.)

Related Projects/Activities: This project sustains continuing efforts in project areas such as:

- ATCT/TRACON Establishment, Replacement and Modernization (2-13)
- Communications Facilities Consolidation (4-02)
- VORTAC (4-03)
- Nondirectional Beacons (4-04)
- Runway Visual Range (4-08)
- Visual Navaids (4-09)
- Approach Lighting System Improvement Program (4-10)
- Large Airport Cable Loop Systems (6-05)
- Power Systems (6-07)
- Unmanned Facilities (6-08)
- ARTCC Plant Modernization (6-09)
- Aircraft and Related Equipment (6-12)
- NAS Spectrum Engineering (6-15)
- General Support (6-16)
- System Support Laboratory (6-17)
- General Support Laboratory (6-18)

SCHEDULE



PROJECT 80: Aeronautical Data Link Enhancements

Purpose: This project implements additional data link services (see Aeronautical Data Link project). The data link processor (DLP) will be enhanced to an end-state configuration to provide for these additional services. It will also provide increased system capacity to handle the higher transaction rates necessary to serve a greater number of Mode S data link equipped users. The additional services will include weather product requests for such data as hazardous weather graphics, ground-initiated hazardous condition message transmission to affected aircraft, and ATC functions performed in conjunction with AAS. ATC applications software development is not included in this project.

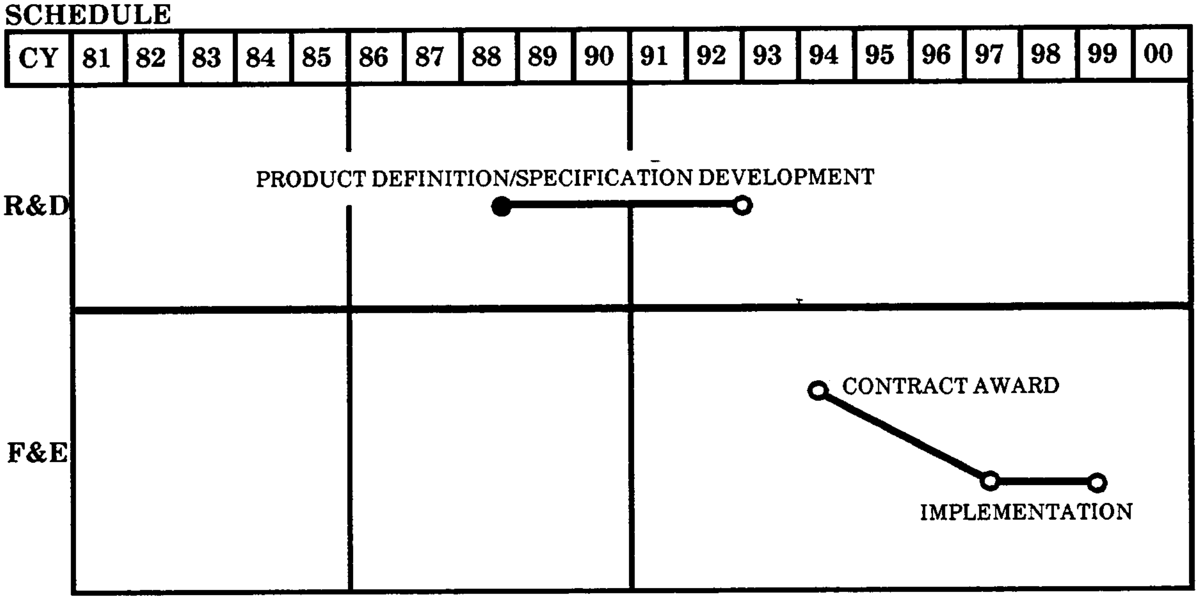
Approach: Based on developed functional and performance specifications for the new services, the DLP hardware system will be augmented or replaced to provide the necessary processing resources. The existing DLP software will be modified and rehosted, as appropriate, to permit the addition of the new data link applications. New interfaces will be developed as necessary (e.g., AAS). Tower Workstation functions will be replaced by a similar functional capability provided by the TCCC.

Products: Hardware and software enhancements for 24 DLP systems, 22 at operational ARTCCs/ ACFs, 1 at FAATC, and 1 at FAA Academy.

Related Projects/Activities:

- CWP - The RWP component of the CWP will interface with the DLP and will provide hazardous weather graphical data to the DLP. The DLP will provide the RWP with pilot reports filed by Mode S data link equipped users.
- WMSC Replacement - The WMSC Replacement will provide NOTAMs and other weather products to the DLP for delivery to Mode S data link users.
- NADIN II - NADIN II and the LCN will provide the telecommunications path between the WMSC Replacement and the DLP.
- LCN - The LCN will provide the telecommunications path between the CWP and the DLP, the AAS and the DLP, the NADIN II packet switch and the DLP, and the ADAS and the DLP.
- Mode S - The DLP will interface with Mode S to transmit messages between aircraft and ground.
- AAS - The AAS will provide data link processing for ATC applications.

SCHEDULE



PROJECT 81: Additional ASDE Establishment

Purpose: This project will provide ground surveillance of aircraft and airport service vehicles on the airport surface at newly qualifying locations. At high-activity airports, radar monitoring of airport surface operations (ground movements of aircraft and other supporting vehicles) is required to maintain aircraft separation, and provide an effective and expeditious means of directing and moving surface traffic. This is especially important during periods of low visibility, such as rain, fog, and night operations.

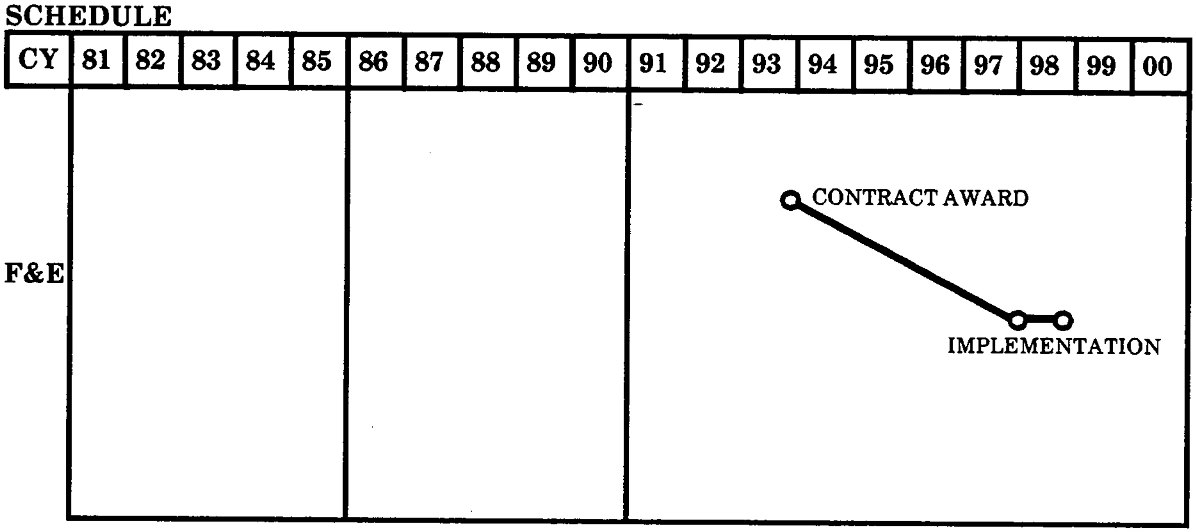
Approach: A new specification will be developed for surface surveillance radar. Candidate locations must meet established criteria which is based on airport activity and weather. A contract for required quantities is expected in 1993.

The ASDE antenna may be located on top of the airport traffic control tower (ATCT) which may require some minor structural modifications. New installations may require structural modifications to the existing ATCT, or possibly a separate remote tower.

Products: Deliveries are planned to begin in 1997, with the last system delivery in 1998. Seven system establishments are currently projected.

Related Projects/Activities: ASDEs will be remote maintenance monitored. Frequency and spectrum engineering is involved with the ASDE implementation. The Airport Surface Detection Equipment (ASDE 3) radar project provides similar equipment in an earlier time frame.

SCHEDULE



PROJECT 82: Parallel and Converging Runway Monitor (PCRM)

Purpose: This project will provide parallel and converging runway monitor (PCRM) surveillance systems that will increase airport landing capacity by allowing simultaneous, independent IFR approaches to (1) parallel runways with separations less than 4,300 feet, and (2) converging runways at reduced minimums below those currently allowed under Terminal Instrument Procedures.

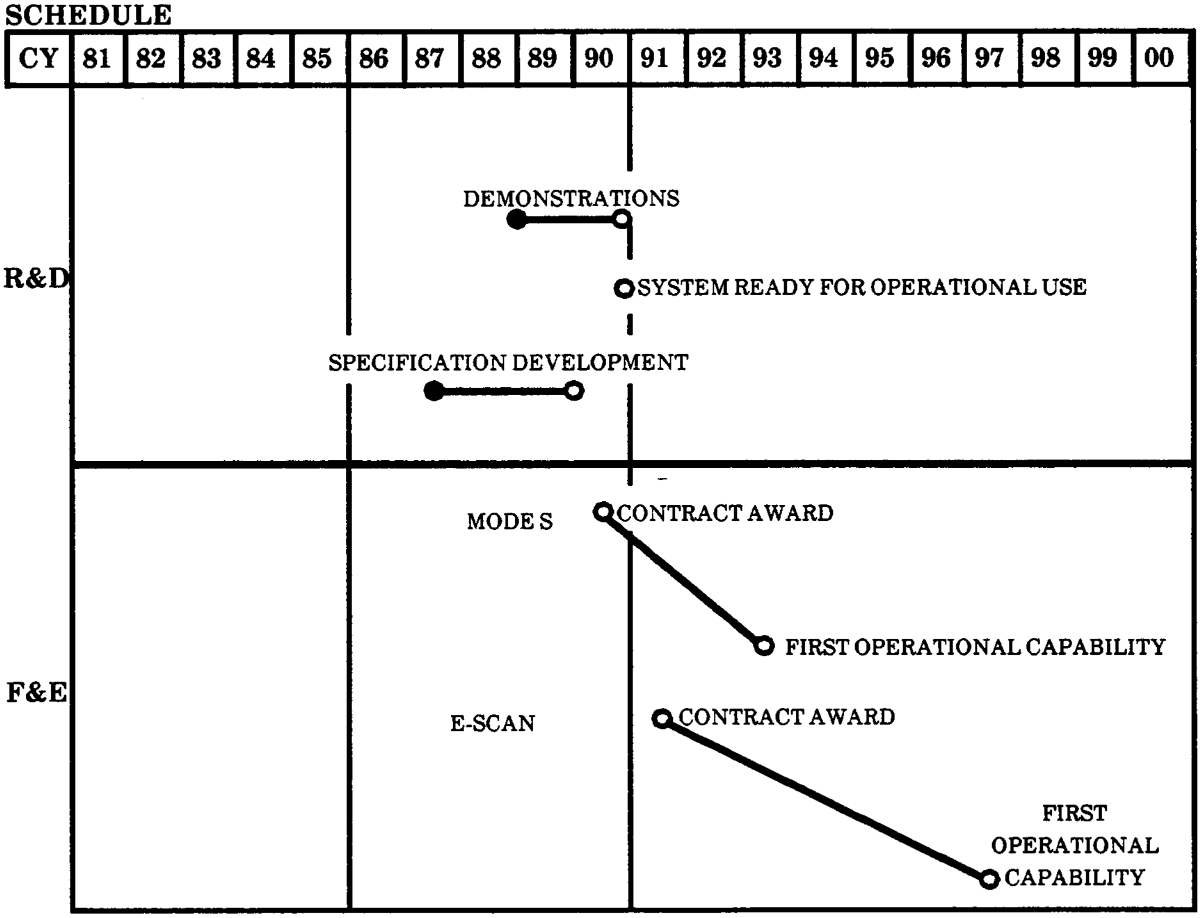
Approach: Two separate test/demonstration programs have been established to simultaneously develop two parallel and converging runway monitor systems to meet the azimuth accuracy, data update, and data display requirements for closely-spaced parallel approaches. One system will use a stand alone electronically-scanned (E-scan), 360 degree circular array antenna to achieve the required azimuth accuracy and data update rates. The other system will use the Mode Select (Mode S) beacon system, modified to increase only its data rate, as Mode S already meets the azimuth accuracy requirements.

Following successful completion of the two test/demonstration programs, these programs will provide production PCRM specifications and cost/benefit studies to determine the best PCRM system for particular sites. These specifications will be used in procuring PCRM production systems. Demonstration systems may be converted for immediate operational use.

Products: Ten existing airports (and possibly two future airports) with closely spaced parallel runways have been identified as candidate locations where airport capacity would be increased immediately if suitable surveillance monitors were available during instrument meteorological conditions. Production quantities of one or both types of PCRM systems will be produced and implemented as required. Interim systems may be utilized to achieve operational capability at an earlier time.

Related Projects/Activities: Raleigh/Durham and Memphis test/demonstration program.

SCHEDULE



PROJECT 83: Integrated Radar Beacon Tracker (IRBT)

Purpose: The project provides for improvements in the timing, tracking, and display of aircraft position data and for the orderly transition of the ATC system from the present configuration to the ACF mode of operation.

Approach: An IRBT will be developed and installed at sensor locations equipped with Mode S and a radar. The IRBT will simultaneously correlate beacon and radar reports into track data. A portion of these functions are currently performed serially and will be upgraded to reduce processing time. Methodology incorporated into the IRBT will provide the following advantages:

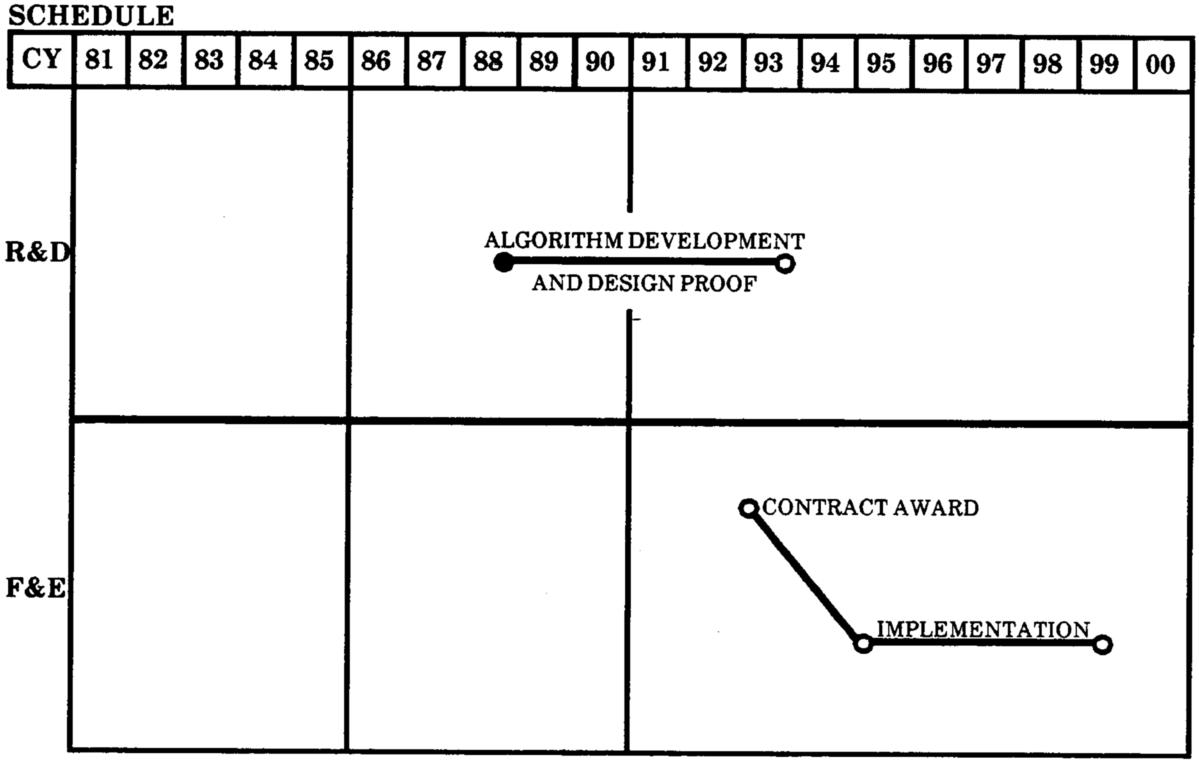
- Track data will be displayed earlier due to the simultaneous processing.
- Performance of this processing and establishment of surveillance file numbers at the sensor site will reduce the AAS processing load.
- Extended range and azimuth accuracy with Doppler velocity available from new sensors will be used to improve tracking, conflict alert and MSAW, and to reduce track swapping.
- The IRBT will provide track evaluation to aid the AAS in processing of responses from more than one sensor site.

The Advanced Format for Radar/Beacon Target Reports will be required to transmit IRBT generated data. Both advanced and current formats will be required to support transition.

Products: IRBTs at Mode S systems colocated with a surveillance radar.

Related Projects/Activities: ASR 9, ARSR 4, Mode S, AAS, ACF, and Advanced Format for Radar/Beacon Target Reports.

SCHEDULE



PROJECT 84: Advanced Format for Radar/Beacon Target Reports

Purpose: This project provides for improvements in the tracking and display of aircraft target data by establishing and implementing a format which can transmit data resulting from enhanced sensor capability. Improvements facilitated by this project include improved accuracy for target positioning, conflict alert and MSAW, reduced probability of track swapping, and the capability to utilize Mode S discrete addresses.

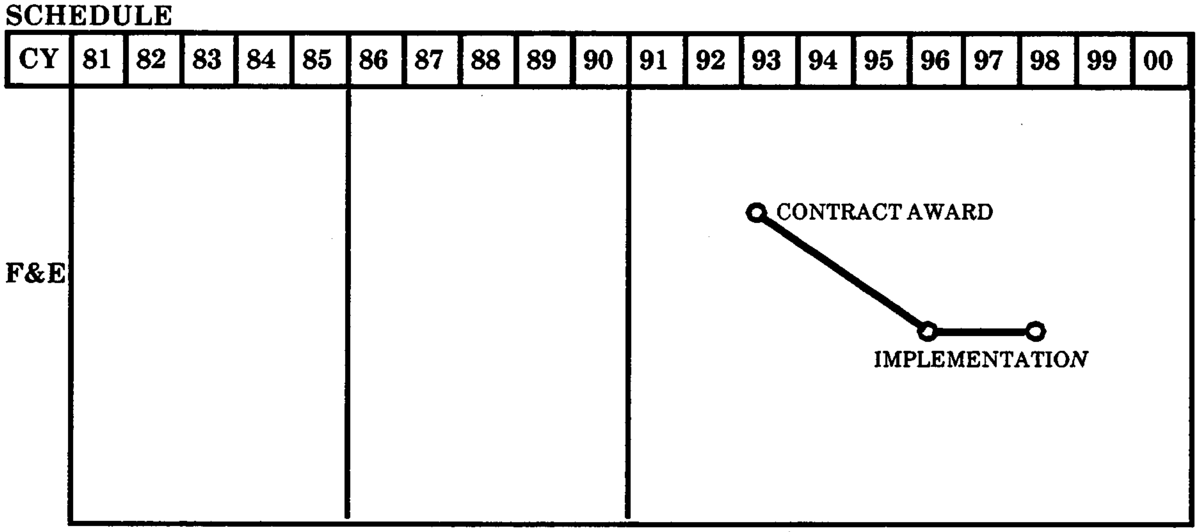
Specifically, the advanced format will allow the transmission of more accurate range and azimuth data, surveillance/beacon file numbers, radar quality, confidence and validity information, Mode S address, and velocity interpolated from Doppler returns.

Approach: The Mode S, ASR 9, and ARSR 4 will incorporate the capability to operate with advanced format information. The advanced format will allow each sensor and combinations of sensors to use full design capability. ARSR 3 radars will be provided with the capability to interface with Mode S units.

Products: Advanced format capability for Mode S, ASR 9, and ARSR 4 sensors.

Related Projects/Activities: ASR 9, ARSR 3, ARSR 4, Mode S, AAS, ACF, and IRBT.

SCHEDULE



PROJECT 90: Runway Visual Range (RVR) Replacement and Establishment

Purpose: This project will continue with the installation of new generation RVRs and satisfy the need for continued replacement of the older, existing RVR systems. Specifically, the modernization of older RVR systems will provide for the previously unbudgeted replacement of Tasker 500 systems and the establishment of new RVR installations.

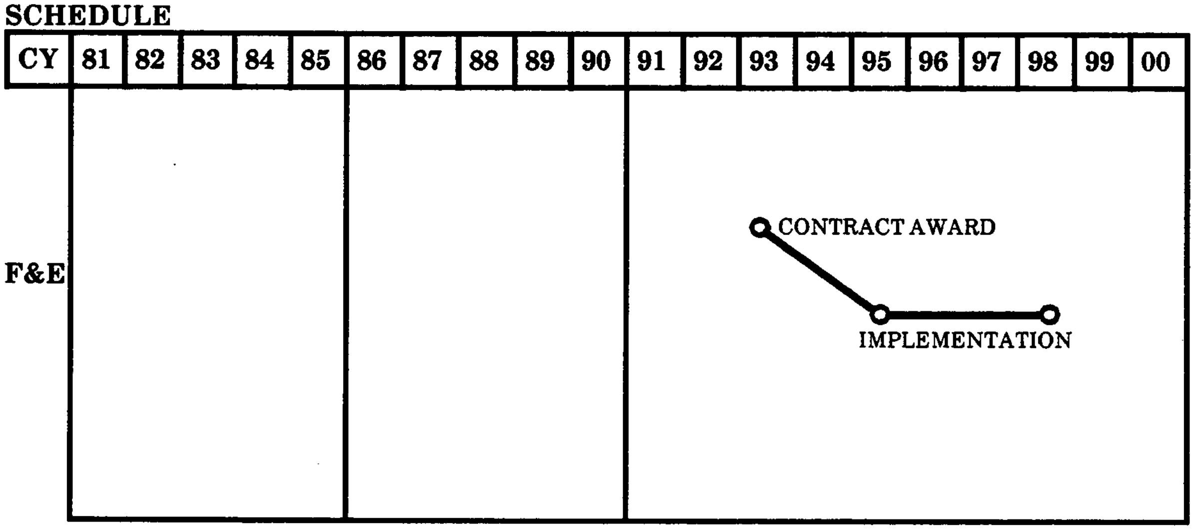
Approach: Provide equipment through a follow-on procurement to complete replacement of old Tasker 500 generation RVRs.

Products:

- Replace Tasker 500 RVRs with new generation RVRs at 178 locations.
- Establish 178 new locations.

Related Projects/Activities: Microwave landing system is a related project.

SCHEDULE



PROJECT 91: ATCBI Replacement and Establishment

Purpose: Surveillance of aircraft for air traffic control, by ground-based equipment, will be required well into the next century. This project will replace aging and obsolete ATCBI equipment with Mode S units. This project will also establish surveillance capability at newly qualifying airports.

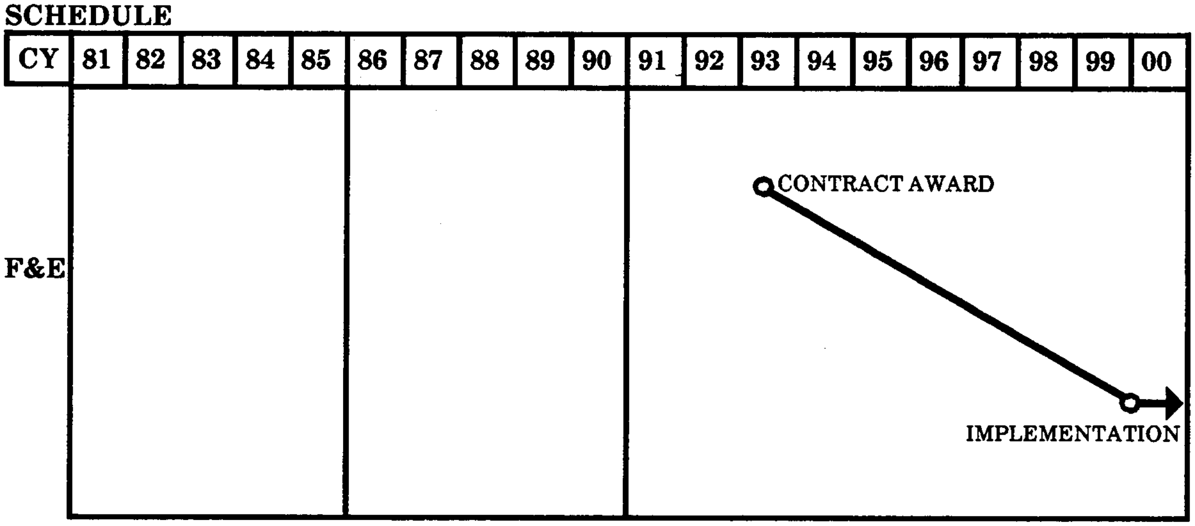
Approach: Ground-based Mode S surveillance units will be procured to replace existing ATCBI equipment and to support new establishments.

Products:

- 199 Mode S units (192 operational and 7 support).
- Options for 19 military sites and other potential requirements.

Related Projects/Activities: Mode S, RMMS, and spectrum engineering are related projects. This project shares a production contract with the Mode S project.

SCHEDULE



PROJECT 92: Long Range Radar Replacement and Networking

Purpose: Should the FAA continue to require primary surveillance for en route air traffic control, it will be necessary to provide the service either by ground-based or satellite equipment. If ground-based equipment continues to be the only feasible mode, we will need to replace the obsolete LRRs in the network. This project describes the ground-based replacement system.

Approach: The Radar Surveillance Network Plan which included Mode S for secondary radar surveillance coverage and data link communications coverage identified a total of 308 existing primary radars (111 long range radars) and 21 beacon-only facilities. To meet current and future coverage requirements and after analysis of problem areas, relocations, deletions, and establishments, the study indicated a requirement for a total of 360 primary radars (120 long range radars) and 32 beacon-only facilities. Approximately 61 new solid-state long-range radars are required to replace tube-type radars by the year 2000.

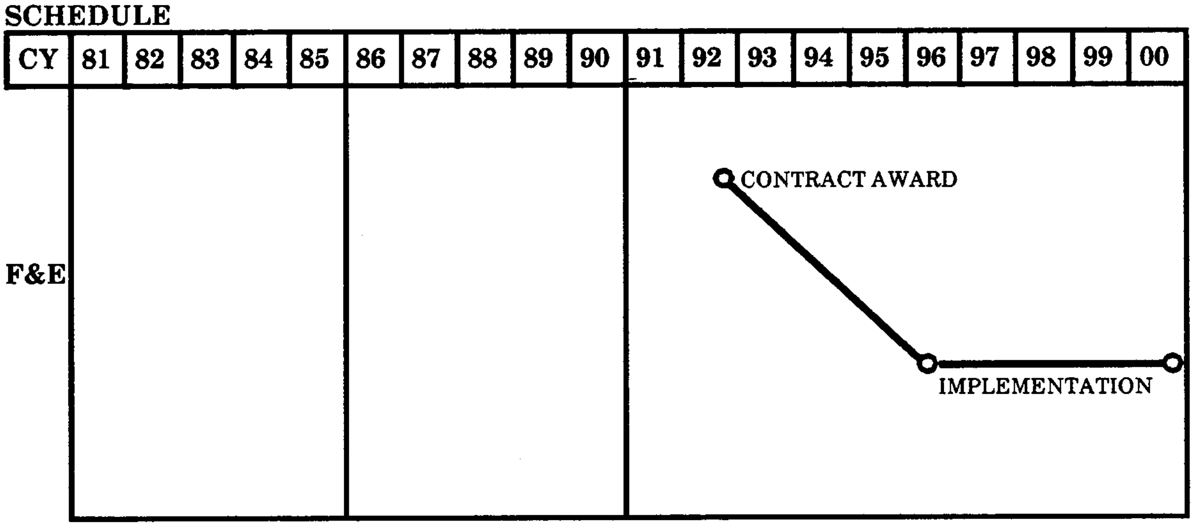
Products:

- Sixty-one (61) solid-state long-range surveillance radars for operational facilities and two (2) for support and relocations, as necessary

- Relocations as necessary.

Related Projects/Activities: This project will require telecommunications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing. RMMS and spectrum engineering are related projects.

SCHEDULE



CHAPTER VIII

TRANSITION

dependent on the successful integration and implementation of many independently procured systems/subsystems. As the plan progresses into and through implementation, requirements are identified that must be acted upon to maintain the safety and integrity of the existing operational system and/or set the stage for a successful transition effort.

To accomplish this, some actions are required to meet the growing demand for ATC services as a result of traffic growth and changes brought on by airline deregulation and hubbing at selected airports. Others are required to ensure the reliability and availability of subsystems and components in light of system age, supply support availability, maintenance problems, and slippage of replacement project schedules.

Additional efforts are required to meet growing demands and congressional mandates, to satisfy new qualifier requirements, and to ensure reliability and supply support of the system. These include expanded automation systems capabilities, additional radars, communications, and landing systems and partial replacements and modifications of others. All funding for these programs is subject to the budget cycle and the annual budget process.

The availability and proficiency of personnel prior to placing a new system/subsystem into the operational environment continues to impact the rate of transition. Operational and maintenance procedures, logistics support, training, system and transition plans must be available and used as guidelines through the total evolutionary process.

Technically, problems arise in the current system that require immediate action to maintain current operating levels, as well as to prepare for major system upgrades. Where shortfalls and constraints exist, efforts must be introduced to resolve issues prior to system impact and/or major ATC functional upgrades.

needs of both the FAA and the user community.

As a result of changes in major NAS Plan programs and the growth in aviation, the FAA must plan for some limited program achievements to alleviate capacity and survivability concerns prior to completing implementation of several long term NAS Plan programs.

This chapter describes system activities requiring an accelerated effort to support the transition from the system of the 1980s to the end state system resulting from the evolutionary implementation of the projects contained in Chapters III through VII of this plan.

OPERATIONAL REQUIREMENTS

The overriding objective behind the evolution strategy is to preserve the safety and integrity of ATC operations while introducing new functions and higher levels of automation to the operational environment. The capability of the system to maintain and/or enhance system capacity in a safe and efficient manner is of prime importance during this transition period. This requires the continual review of ATC procedures and other system components affecting capacity.

When the NAS Plan was first published in December 1981, the Advanced Automation System (AAS) was to replace all of the terminal air traffic control (ATC) equipment. The initial AAS delivery was scheduled for 1991. In 1983, the NAS Plan first introduced the concepts of Area Control Facilities (ACF) which would subsume all of the current terminal ATC functions. Various studies have addressed the ability of the current automated radar terminal systems (ARTS) equipment to survive until their replacement by the AAS systems. These studies identified capacity concerns at some major facilities, the most immediate being New York TRACON, which is in the process of being upgraded.

Operational benefits that will be realized through the restructuring of airspace and the consolidation of TRACON facilities in the Los Angeles basin include: improved traffic flow, reduced procedural complexity and coordination, increased controller productivity, reduced pilot workload, and the enhancement of air traffic safety.

Interfacility data transfer between the Edwards AFB RAPCON and the Los Angeles ARTCC will contribute to improving controller productivity in many ATC facilities, and increasing safety and efficiency of the ATC process.

To meet increased air traffic demands at ARTS IIIA terminal facilities, additional processing equipment will be procured and implemented. Mode C intruder software will also be added to these terminal locations.

Some metroplex areas are planning new airports, or significant expansion of existing facilities. A new commercial service airport is being planned for Denver, Colorado. Facilities and equipment will be provided to support expansion/modernization of airports in the Dallas/ Ft. Worth, Texas area. These improvements will provide significantly increased airport capacity and facilitate safety and efficiency of ATC operations.

The improvement of conditions in the Chicago, Illinois terminal/en route ATC environment will enable the system to maintain existing operations and meet increased traffic demands.

TECHNICAL REQUIREMENTS

Conditions exist in the current environment that require some immediate action to assure the effective continuation of ATC services until NAS Plan projects are implemented. Major concerns are in terminal ATC system capacity and reliability/ availability.

ability.

Interim support action is required to assure continuation of air traffic control and navigation services until completion of NAS Plan programs. These actions involve hardware changes, the addition of controller positions in ATC facilities, and expansion of the automated radar terminal system. These projects will help to maintain system operations, increase capacity, and establish new capabilities at some ATC facilities.

OTHER REQUIREMENTS

The NAS Plan was developed to modernize the technology that supports the people who achieve the FAA mission. The Plan has now matured to the point that it is time to introduce the human resource management component.

Initially, this effort will identify the resources, systems, and procedures required to integrate human resource management and technical system planning. A key aspect will be the clear definition of how the new technology will be used. That definition will allow projections of how the work will change, how jobs should be structured, and what transition issues must be addressed. The FAA will then be able to plan the transition of its current and future work forces.

Operational procedures, staffing, training work force relocation, communication, and funding issues will be addressed with a view toward both the transition demands and the end-state NAS. Most FAA employees will be affected by the transition. The agency must evaluate the knowledge, skills, and abilities which managers, supervisors, technicians, and controllers will need.

addressed. The use of contractor assistance is included in our plans to address this transition need.

- The introduction of the new controller work stations and new communications networks will greatly impact the controller's physical environment. Further, the organization of the new equipment into Area Control Facilities which will result in the collocation of terminal and en route functions in the Air Route Traffic Control Center environment will impact the systems and procedures for managing the duties of air traffic control, maintaining the systems, and organizing the work force.

commitment, and quality of worklife of the personnel who operate and support the NAS must be taken into account.

In order to ensure a smooth transition of the ARTCC from the current configurations to those required for ACFs, the existing and projected administrative, support, and operations space shortfalls are being addressed.

A long range plan for centralized logistics support functions of the Aeronautical Center will be formalized. This plan will be based on integrated logistics support concepts and technology for training, maintenance, and supply support that are responsive to NAS Plan project requirements.

20. Southern California Terminal Airspace Realignment (STAR)/ Terminal Los Angeles Basin Service (T-LABS)	1987	1994
21. Interfacility Data Transfer System for Edwards AFB RAPCON	1994	1994
22. Expand ARTS IIIA Capacity and Provide Mode C Intruder (MCI) Capability	1991	1992
31. New Airport Facilities, Denver, Colorado	1989	1992
32. Dallas/Fort Worth Metroplex	1989	1993
33. Chicago Area Improvements	1988	1993
TECHNICAL REQUIREMENTS		
41. ILS (GRN-27) Replacement	1993	1996
51. Interim Support Plan	1990	1994
OTHER REQUIREMENTS		
70. Human Resource Management	1990	2000
71. ARTCC/ACF Support Space	1991	1995
72. Aeronautical Center Centralized Integrated Logistics Support (ACCILS) Plan	1992	2000

PROJECT SUMMARY

reduction of traffic delays and the enhancement of air traffic safety.

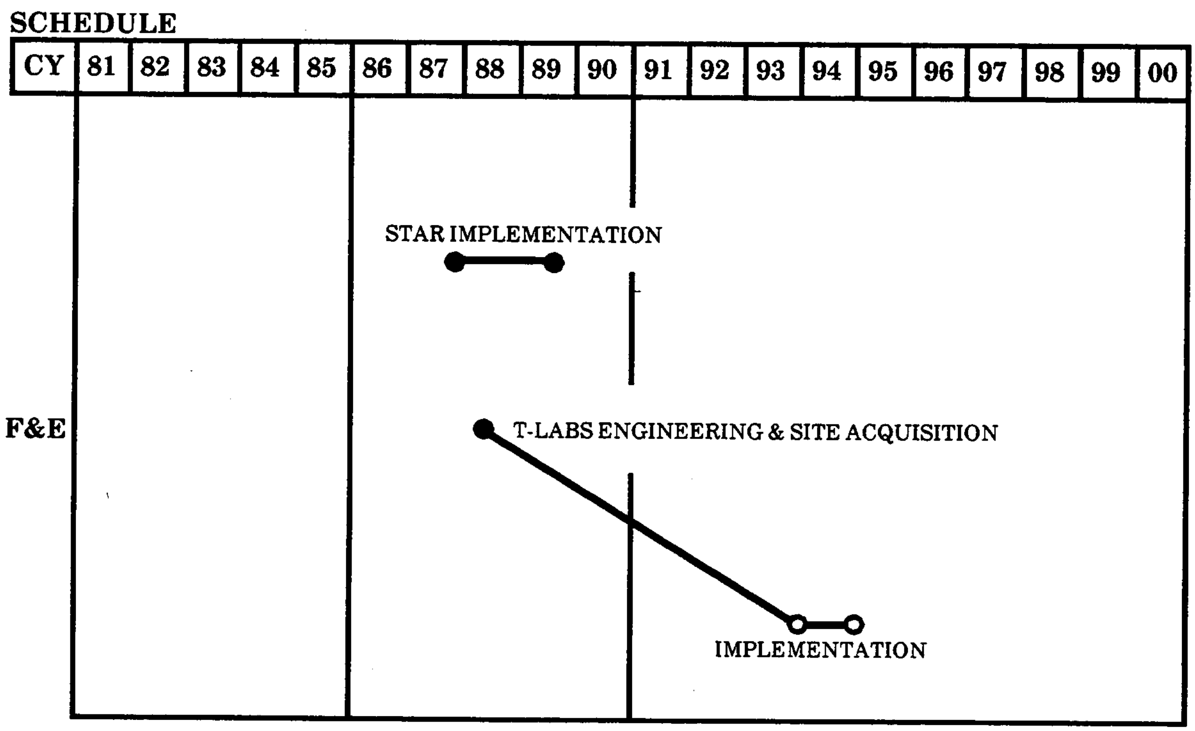
Approach: The STAR phase of the program involves major restructuring of the Los Angeles Basin airspace utilizing present NAVAIDS and existing TRACONs. Some additional sector equipment including displays, communication and other operational components will be required to support this initial endeavor.

The T-LABS portion of the project involves activities necessary to consolidate four Los Angeles Basin ARTS IIIA TRACONs into a common ATC facility.

Products:

- Restructured airspace and associated ATC operational equipments to improve management of air traffic in the Los Angeles Basin area.
- FAA facilities and equipment to support the establishment and operation of a common TRACON service for the Los Angeles Basin area.

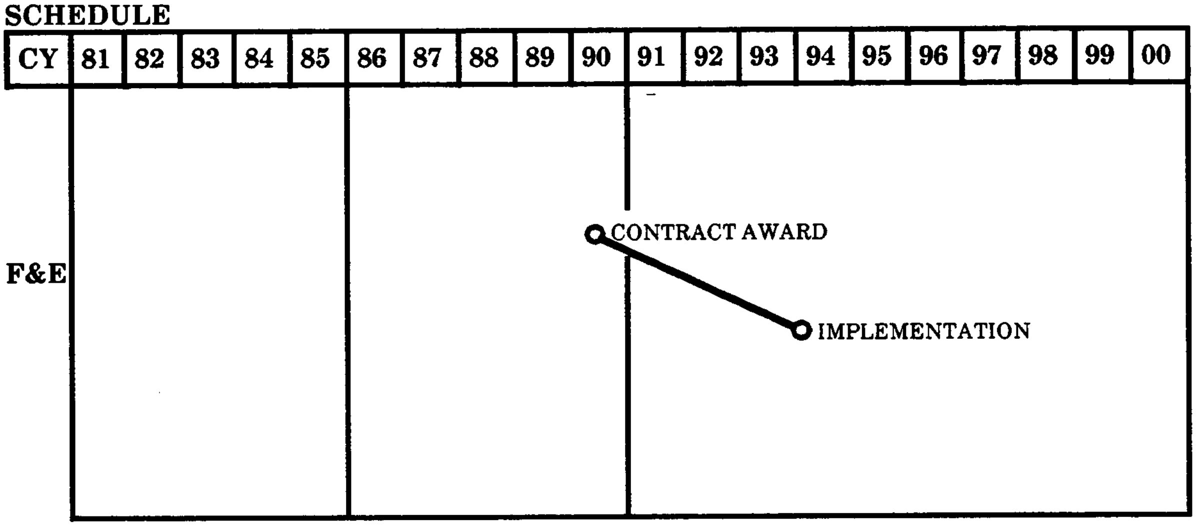
Related Projects/Activities: ACF, VSCS, RCL, RCE, HCVR, etc. Products will be procured through related projects and contracts to the extent possible.



continue with the national program of expanding tower en route control.

Related Projects/Activities: None.

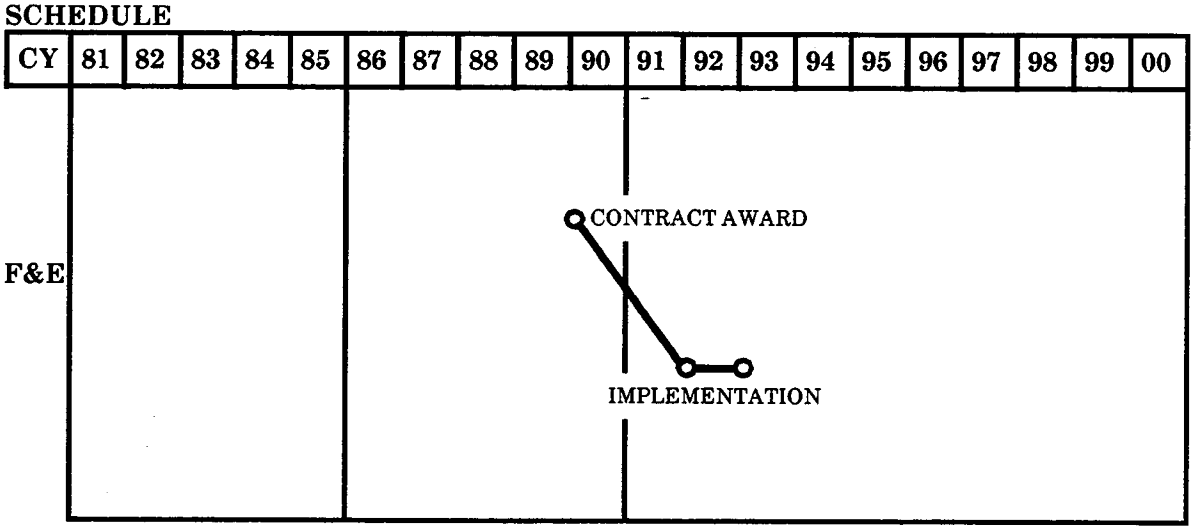
SCHEDULE



capability, two to four additional IOPs will be added to the current system. MCI software will be procured and implemented into existing ARTS IIIA systems. Ancillary ARTS IIIA hardware including logistics

Related Projects/Activities: ISP. Products will be procured through related projects and contracts to the extent possible.

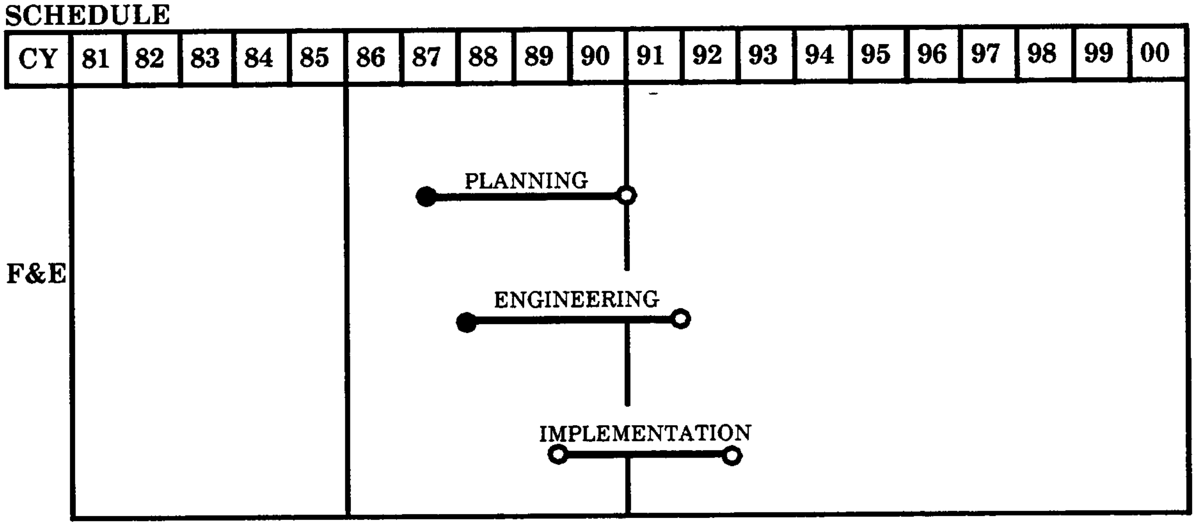
SCHEDULE



Approach: Plan, engineer, procure, install and integrate the FAA facilities and equipment required to support the use of the new commercial service airport. An airport traffic control tower and terminal approach control facilities will be provided as well as communications, navigation, landing, surveillance and automation equipment.

relocated systems, ACF, ISP, VORTAC, ILS, MLS, ASR, ASDE, interfacility communications, RVR, visual aids, multi-channel voice recorders, TCS, LLWAS, ASDE, large airport cable loop systems, flight data entry and printout devices, DBRITE, ATIS, TDWR, RCE, etc.

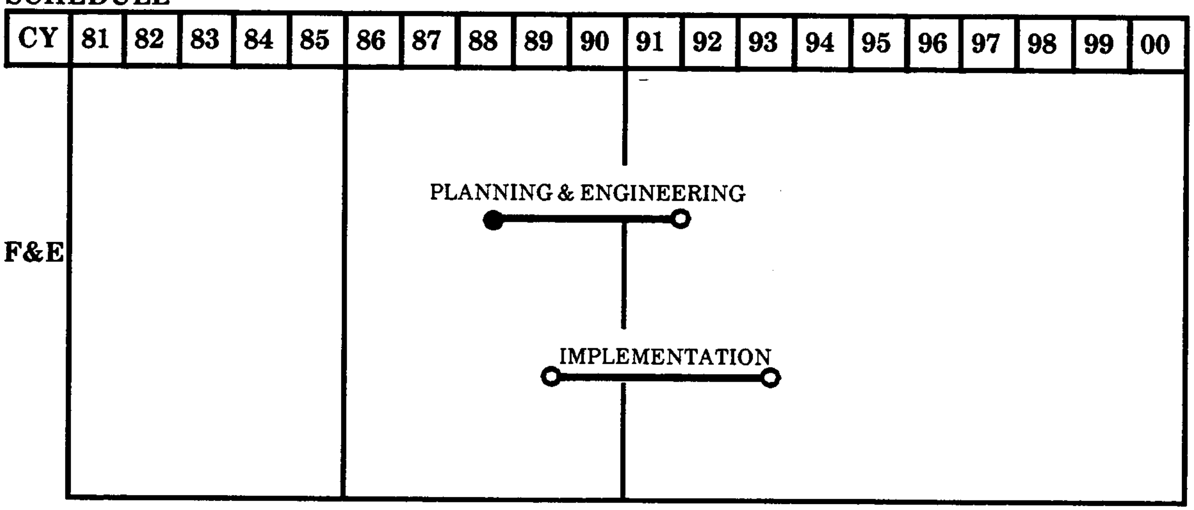
SCHEDULE



integrate the FAA facilities and equipment required to support the use of new/expanded commercial service airports in the Dallas/Ft. Worth area. A total of twelve reliever airports capable of turbo-jet operations will benefit as a result of implementation of this plan. Airport traffic control towers and terminal air traffic control system in the Dallas/ Ft. Worth, Texas area.

Related Projects/Activities: ATCT, ACF, ISP, VORTAC, ILS, MLS, ASR, and interfacility communications, RVR, visual aids.

SCHEDULE



ization and traffic routing plans for all Great Lakes Region en route facilities will be conducted in light of their interdependence regarding the handling of Chicago traffic. In depth reviews will be conducted on existing plans, contracts and delivery schedules of NAS components in the Chicago area. These reviews will address operational and maintainability issues associated with those schedules as related to the capability to maintain existing operations and meet increased traffic demands on the system.

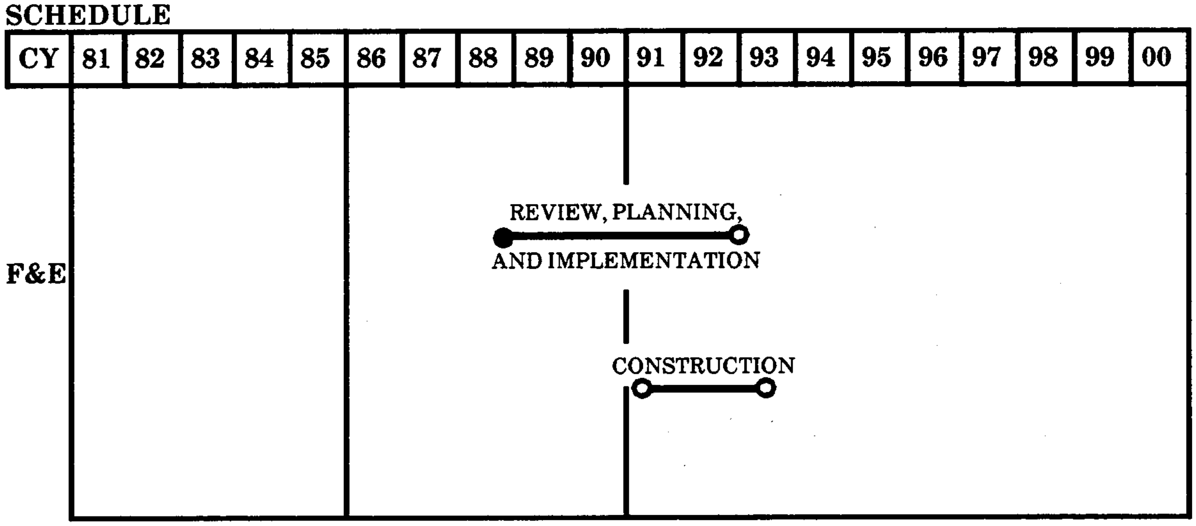
A task force will be established to review and recommend changes to Chicago area airspace and procedures, including: standard routing programs such as segregation of O'Hare arrivals and departures from Midway and other satellite airport traffic flows; and traffic procedures for Midway such as separate feeder fixes and arrival/departure corridors. In conjunction with these efforts, planning will be initiated for location survey and site selection for relocating and establishing a new Great Lakes radar control facility. A modern tower cab facility will be constructed either on an existing structure or on a new site based upon the results of an A&E study.

Also considered for accomplishment:

- Installation of environmental remote maintenance monitoring at critical facilities throughout O'Hare airport such that realtime status of these facilities is available.
- Provide modern ATC facilities.
- Improve voice and data communications reliability within the Chicago area airspace.
- Standardize and modernize navigational aids, including RMMS, and airport markings at Chicago O'Hare.
- Develop changes in airspace procedures to increase operational efficiencies.
- Provide additional controller displays, Aircraft Situation Display (ASD) and improved weather displays for the O'Hare TRACON.
- Provide expedited delivery of NAS Plan systems to the Chicago area.

Related Projects/Activities: ATCT/TRACON establishment, replacement and modernization, ACF, ISP, VORTAC, ILS/MLS, ASR, RVR, visual aids, cable loops and interfacility communications.

SCHEDULE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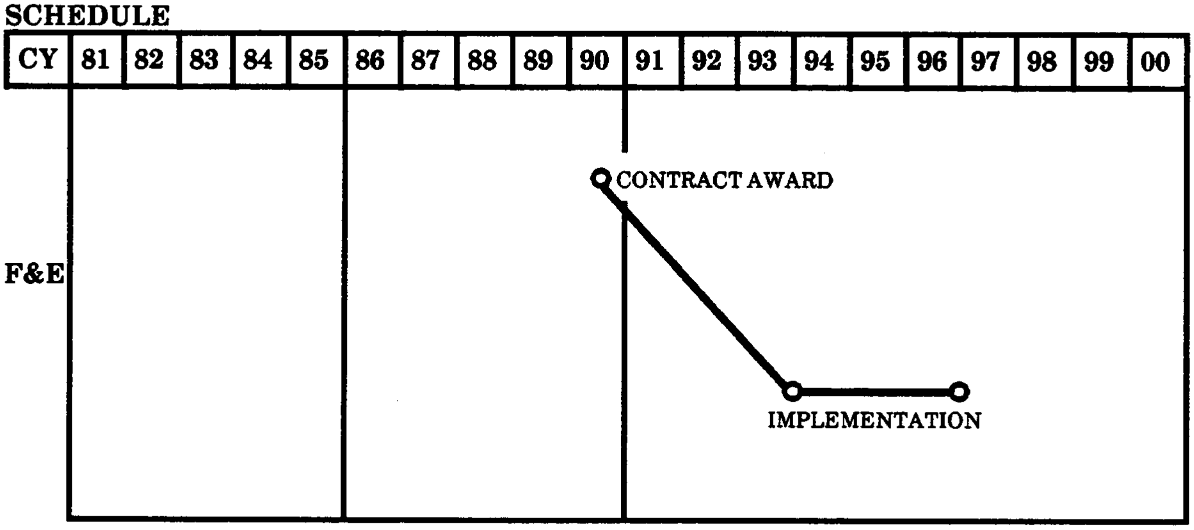
F&E
REVIEW, PLANNING,
AND IMPLEMENTATION
CONSTRUCTION

in order to resolve severe logistics support problems, and to maintain the integrity and reliability of these

replaced under the Interim Support Plan.

SCHEDULE



Approach: FAA has defined interim support actions which are consistent with current NAS Plan schedules, require no R&D efforts, and can be implemented with maximum use of off-the-shelf devices and existing contracts. These actions involve hardware replacement (including logistics support), the addition of new operating positions at existing facilities, and software modifications to expand the capacity of some ARTS systems.

Products:

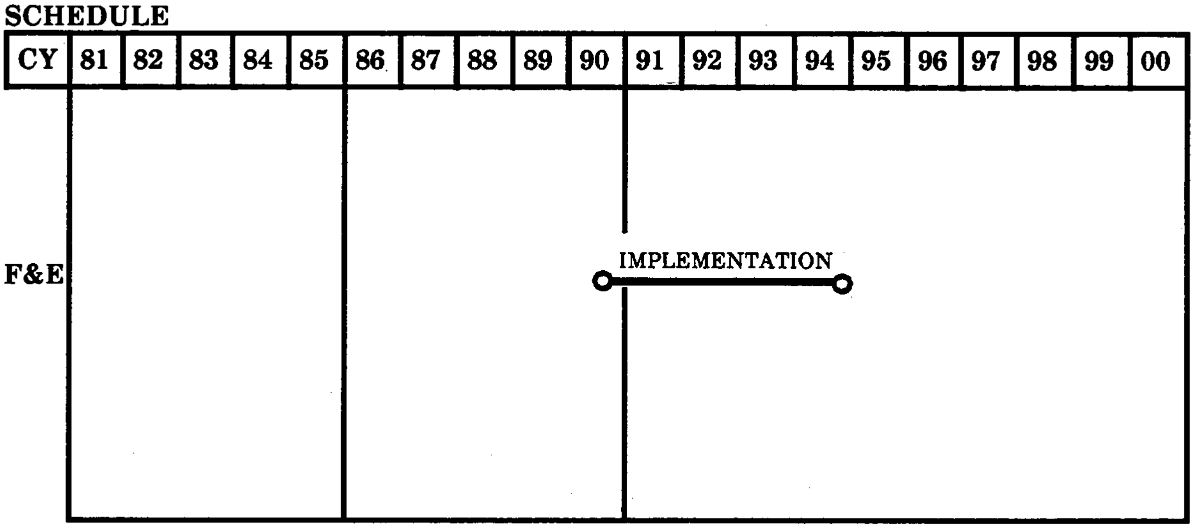
- Solid state memory for ARTS IIIA/EARTS.
- Multi-sensor/multiprocessor capability at additional locations.
- Separate flight plan data file for ARTS IIA.

(option).

- Uninterruptible power supply for critical ARTS IIA sites.
- ICSS emergency bypass.
- EARTS provisioning.
- Replacement ceilometers and hygrothermometers.
- Replace 10 ILS systems and upgrade antennas.
- Solid state kits for long range radar upgrade.

Related Projects/Activities: Products will be procured through the use of related projects and contracts to the extent feasible.

SCHEDULE



transition.

The major objective of the HRM Plan is to establish an orderly process for effectively managing such issues as staffing, training, and relocating people so the NAS technology can be used effectively as it is delivered. The Plan will be based on the principle that FAA's goals for operational effectiveness, high levels of productivity, quality service, and a positive organizational culture can best be achieved through carefully considering and managing the transition of its people.

Approach: The plan will be updated annually to integrate new or modified requirements. The update process will be designed to ensure the full support and accountability of all affected organizations in the implementation of the NAS transition.

The first iteration of the HRM Plan will cover the Airway Facilities, Air Traffic, FAA Academy, FAA Depot, and Technical Center workforces. As the planning process matures, the HRM Plan will expand to include all affected employees and more precise projections over longer time frames.

The plan will be developed through a coordinated process between the Air Traffic, Airway Facilities, NAS Development, Aeronautical Center, and Human Resource Management organizations. Each organization will be responsible for production of the portion of the plan that addresses their operations, policies, and human resources. The Human Resource Management organization will establish and assure standardization to achieve a cohesive approach. An oversight committee of top managers will guide the

- Define planning criteria and guidelines.
- Specify types of analyses that will form the basis of the plan.
- Define specific methodologies and tools to be used for development of plans to ensure consistency of planning objectives and outcomes.
- Establish schedules and assign responsibilities for accomplishment of required actions.
- Detail funding and other resource requirements and sources to support the planning process.

Phase 2 will develop the HRM Plan. Phase 3 will implement the plan developed in Phase 2.

The HRM Plan will address:

- Projected changes to operational procedures and policies resulting from new technology.
- Projections of the nature of the work and the structure of jobs at significant points.
- Staffing plans based on projections of the number of people and the skill requirements necessary to operate, staff, and maintain the NAS during transition. These projections will take into account forecasted attrition, developmental pipelines, training time required for full performance level employees, periods of switch-over from one system to another, and facility consolidation procedures.

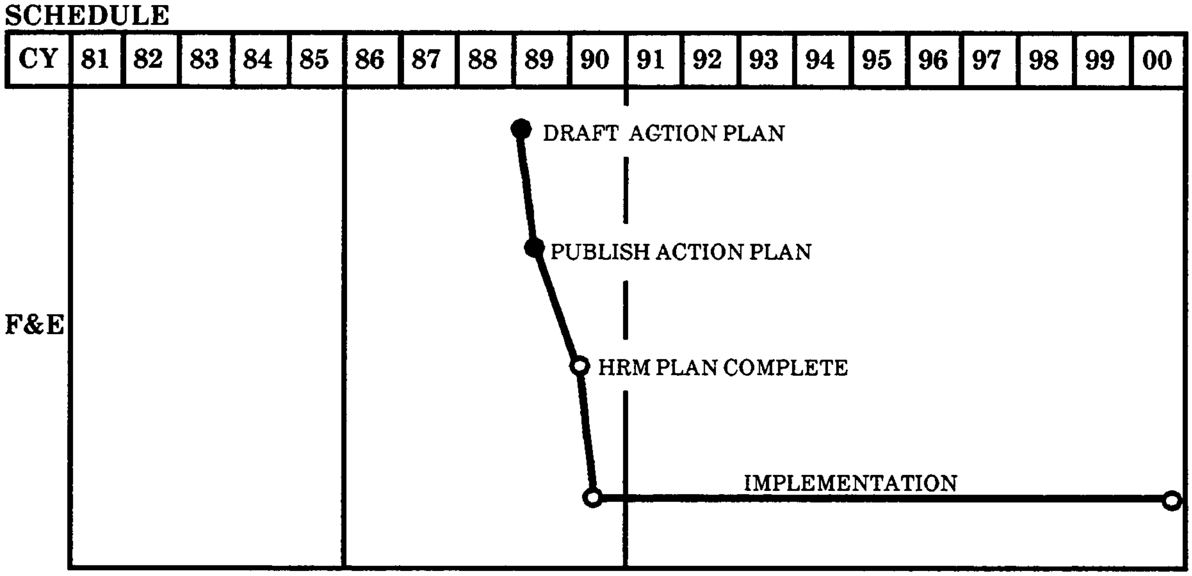
- Planning for other key work force issues including impacts of facility consolidations and the relocation of people. Strategies for taking into account the employees' personal needs and goals in the relocation process will be outlined. Standards for dealing with these employee concerns will be developed to guide regional planning.

plan for the FAA.

Product: Human Resource Management Plan.

Related Projects/Activities: This program supports ongoing F&E and operations activities.

SCHEDULE



Regional studies were reviewed and an independent study was conducted by the System Engineering and Integration Contractor (SEIC) to determine existing capabilities and validate future ACF projections.

Approach: The objective of space management is to make optimum use of space at existing NAS facilities. This is accomplished by logically preparing and scheduling construction of new areas, and by managing the configuration and utilization of facility and building space with respect to hardware, environmental, operations, and maintenance personnel. All user requirements for space are included as well as applicable standards for allotment of space to equipment, people, and operations.

ACF estimates were based on the end-state configuration, with staffing levels and authorized space requirements generated from guidelines established in agency directives and orders.

Current/interim/future ARTCC airway facilities and air traffic administrative and support space shortfalls have been identified in the following areas: "standard" and 4 "unique" ARTCCs and the NY TRACON. These requirements will be integrated with other construction projects at specific ARTCCs.

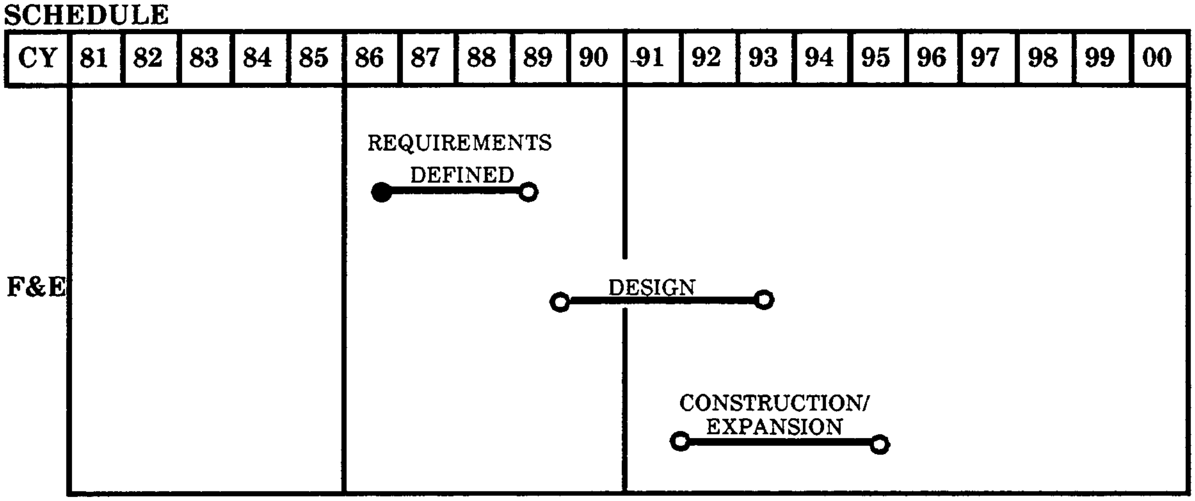
Products:

- 18 updated standard ARTCC/ACF environments providing space for human resources and support activities needed to manage the Area Control Facility concept described in the NAS Plan.

- 4 updated unique ARTCC/ACF environments and the New York TRACON/ACF.

Related Projects/Activities: The expansion and reallocation of space within the ARTCC will require coordination with other activities scheduled to transition into the ARTCC. Requirements for ARTCC building modernization, relocation of equipment, asbestos removal, and upgrade/ expansion of power systems will be accomplished under separate projects contained under Chapters III through VII of this plan.

SCHEDULE



Centralized Integrated Logistics Support (ACCILS) plan is to establish a set of goals, concepts, and expectations (end state) for the Aeronautical Center to use to establish an orderly process to effectively respond to installation, maintenance, operation, and support of the NAS Plan projects.

Approach: The plan will be updated at significant change points in the NAS evolution. The plan will be baselined for configuration management purposes, and full accountability to all affected organizations and programs will be maintained.

The first iteration of the plan will develop and define goals, concepts, and expectations in terms of NAS Plan end-state centralized-support functions and in terms of the current baselined centralized support functions. The iteration will include recommendations for intermediate planning points. It will be confined to the total, high level centralized support function and interfaces. In subsequent iterations, the plan will develop and document substantive detail of requirements, including space, physical security, redundancy of capability, and human resources.

The plan will be developed by the Aeronautical Center in coordination with all organizations that rely on the centralized support functions of the Aeronautical Center. Standardization of requirements will be highlighted to assure cost effective and responsive support functions and programs. An oversight committee of top managers, internal and external to the Aeronautical Center, will be established to guide the development process.

centralized-support functions.

- Establish and acquire resources (F&E funding and contractual support).

Phase 2 - Develop Plan

- Utilizing the products of phase 1, develop, coordinate and issue the first iteration of the plan defining NAS Plan end-state centralized support requirements.

Phase 3 - Develop Detailed Sublevels of Plan

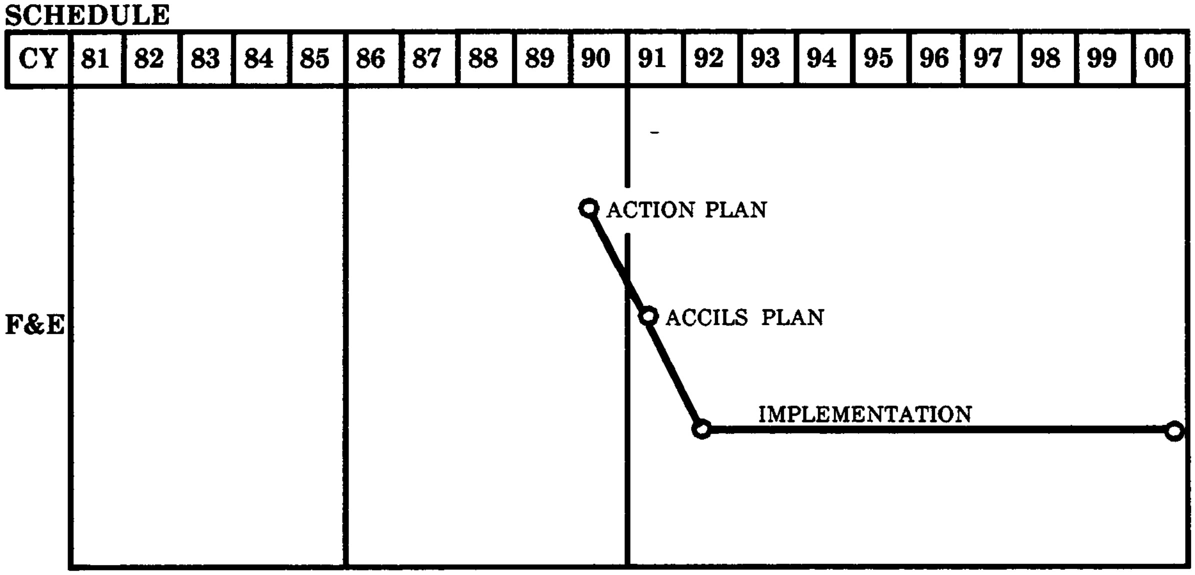
- Building on phase 2 efforts, develop detailed processes, functions, and requirements.

The plan will provide a basis for centralized support resource allocation, functional assignment, capability definition, program/project support resource responsibilities, management requirements, etc. Knowing the baselined ACCILS Plan configurations and capabilities, managers, supervisors, planners, and program managers, as well as users can determine and define their interface and functions for cost effective out year program execution.

Products: Aeronautical Center Centralized Integrated Logistics Support Plan.

Related Projects/Activities: This program supports ongoing F&E and Operations activities.

SCHEDULE



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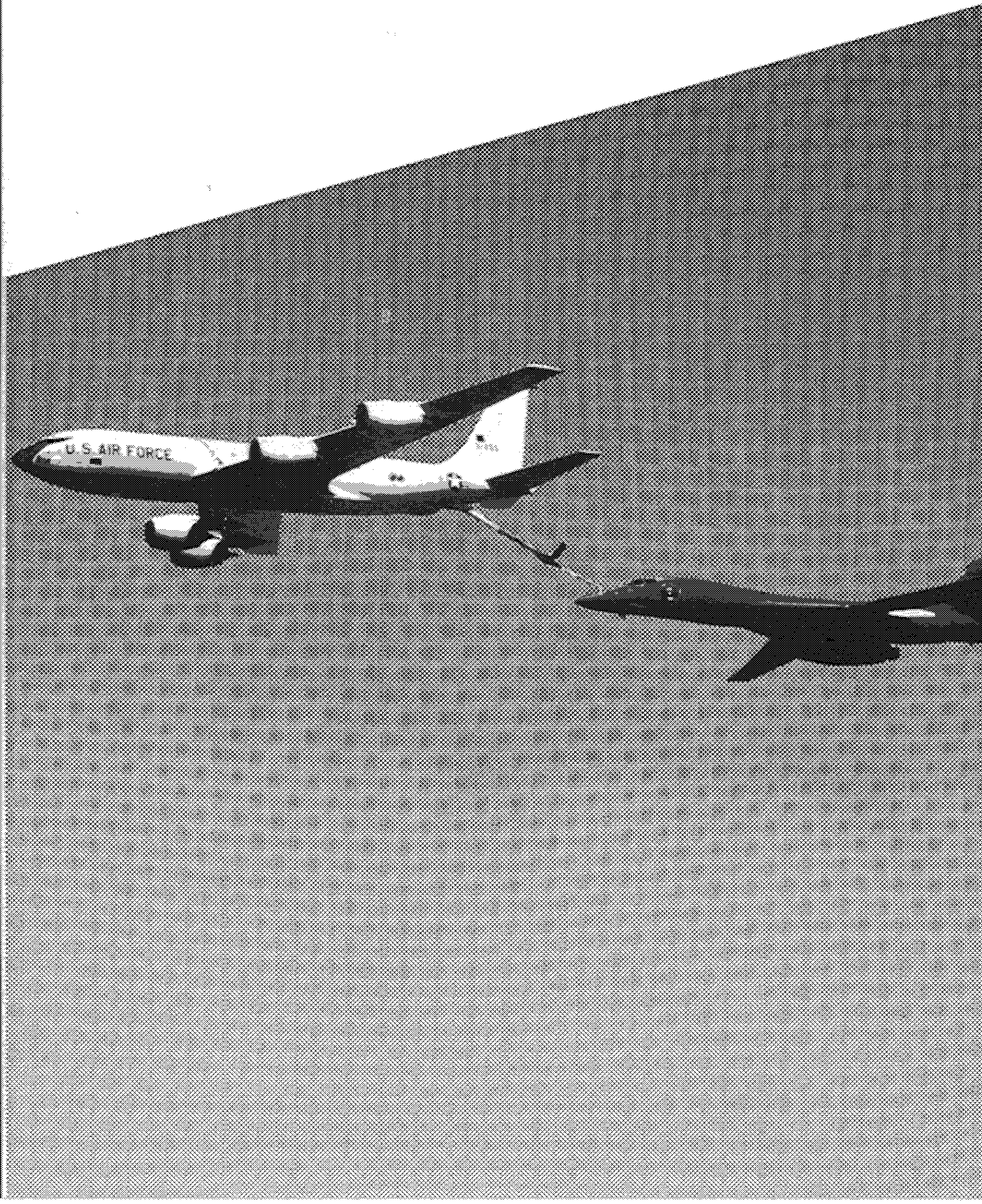
ACTION PLAN
ACCILS PLAN
IMPLEMENTATION

CHAPTER IX

DOD/FAA OPERATIONS



OVERVIEW

The Federal Aviation Administration (FAA) National Airspace System (NAS) Plan for modernization and improvement of Air Traffic Control (ATC) and Airway Facilities (AF) through the year 2000 will evolve, basically, through consolidation of facilities and implementation of higher levels of system automation. The Department of Defense (DOD) plays a large role in the NAS as both a major provider of ATC services and as a major user of the national airspace system with unique user requirements. On average, the DOD facilities control twenty-five percent of all air traffic handled in the NAS each day (see Figure 9-1). Future DOD ATC facilities must interface with several new FAA systems and facilities, such as the Advanced Automation System (AAS) and the Traffic Management System (TMS). Therefore, the DOD is substantially affected by and must be a full participant in the NAS Plan. Hardware and software upgrades will be necessary to ensure DOD ATC facility interoperability and compatibility with FAA long-term NAS improvements. The FAA implementation of the NAS Plan will have measurable impact on all aspects of ATC services provided by and used by the DOD. The new NAS ATC systems require greater concentrations of software, more digital interfaces, and provide more sophisticated data to the controllers. Without compatible levels of automation and modernization in DOD facilities, there will be a significant

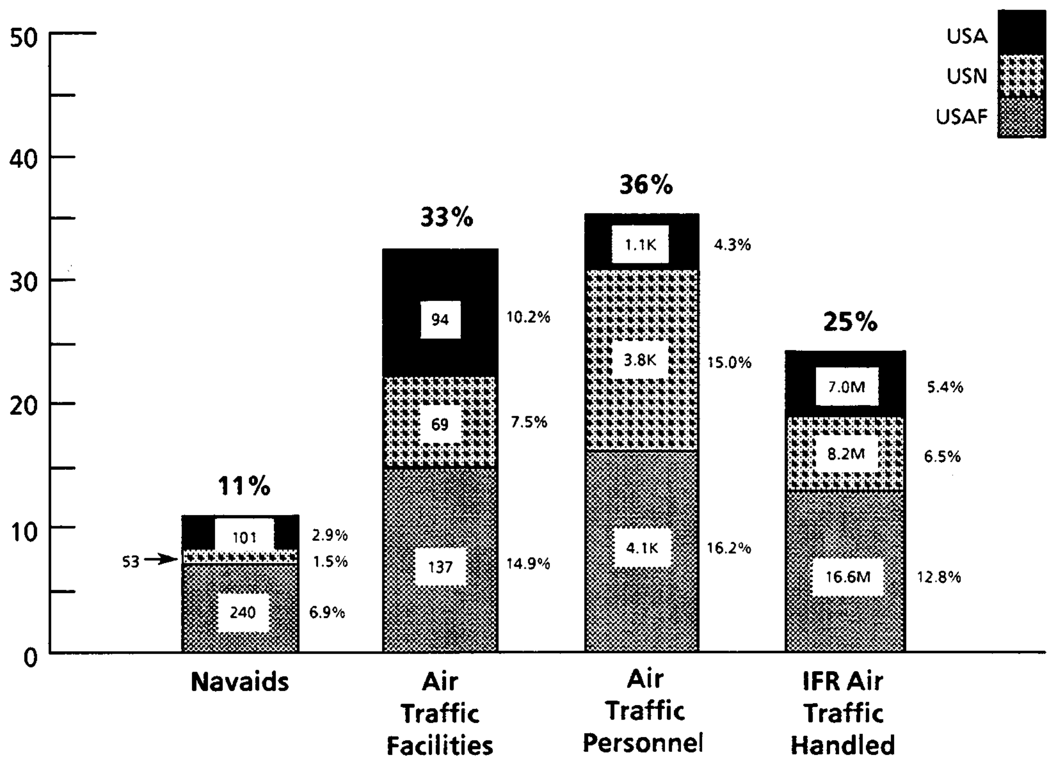


Chart indicates 1988 Data obtained from United States Armed Forces

DOD	394	300	9.0 K	31.8 M
FAA	3054	619	16.3 K	97.6 M
Total	3448	919	25.3 K	129.4 M

FIGURE 9-1: WHAT IS THE DOD ROLE IN THE NAS?

disparity between the quality and level of services provided by DOD controllers, compared to that provided by the FAA. NAS planning and system design must recognize the presence and continued need for DOD ATC facilities to provide services within the NAS to military and civil aircraft alike. Modernization efforts by FAA must recognize the continued need for DOD facilities to interact efficiently with those of the FAA. This chapter describes the DOD's NAS Plan implementation goals, assumptions, and planning activity. It is DOD's intention to fully integrate its planning activity with that of the FAA to further enhance overall NAS Plan implementation. This integration of DOD and FAA activities will be reflected in future versions of the NAS Plan.

DOD and FAA jointly authored a memorandum of agreement (MOA) that states national policy for joint FAA/DOD ATC services. Sub-agreements to that MOA discuss the realignment of approach control responsibility at some FAA and DOD facilities in the years 1995 and beyond. The MOA identifies the approach controls affected and provides policy governing their acquisition of equipment, engineering and maintenance responsibilities, joint facility staffing, general funding guidelines, and where applicable, transfer/transition of authority. The approach controls identified are grouped as follows:

1) approach controls transferred to FAA from DOD, 2) approach controls transferred to DOD from FAA, 3) Air Force bases controlled by Air Force controllers located in an FAA ACF, 4) facilities operated from DOD Consolidated Radar Facilities (CRFs), 5) DOD approach control facilities remaining unchanged, and 6) exceptions to the above five groupings. This MOA was signed on December 14, 1988.

MILITARY AVIATION REQUIREMENTS

Response to military requirements places special demands on the NAS, particularly in the en route airspace where most Special Use Airspace (SUA) is located. The FAA provides approach control services for over half of the 233 military airfields in the United States. The military services provide the rest by operating 56 approach control facilities and 180 control towers (see Figure 9-2). The DOD operates over 20,000 aircraft within the NAS, flying approximately 6,000,000 hours a year Over 90 percent (5,400,000+ hours) of this flying is dedicated to training missions. These training missions include high-speed maneuvering flight at all altitudes, with increasing need for very low-level operations. Increased air refueling activity, aircraft and weapons system testing, air drop missions, and frequent large-scale joint exercises require close coordination with the FAA to balance airspace usage with civil traffic and ensure safety. The increased speed, range, and capabilities of military flight operations also indicate that DOD will place a somewhat higher level of demand on the NAS for training and testing, even though the total number of military aircraft will remain relatively constant. A relatively small amount of the nation's airspace is reserved exclusively for military use. Therefore, there will be a need for improved coordination and ATC services if growing civil and military aviation requirements are to be accommodated at the current (or at an improved) level of safety with the NAS.

GOALS

The DOD's continuous overall goal is National Defense preparedness. The following specific objectives, relative to military aviation, are supportive of that overall preparedness:

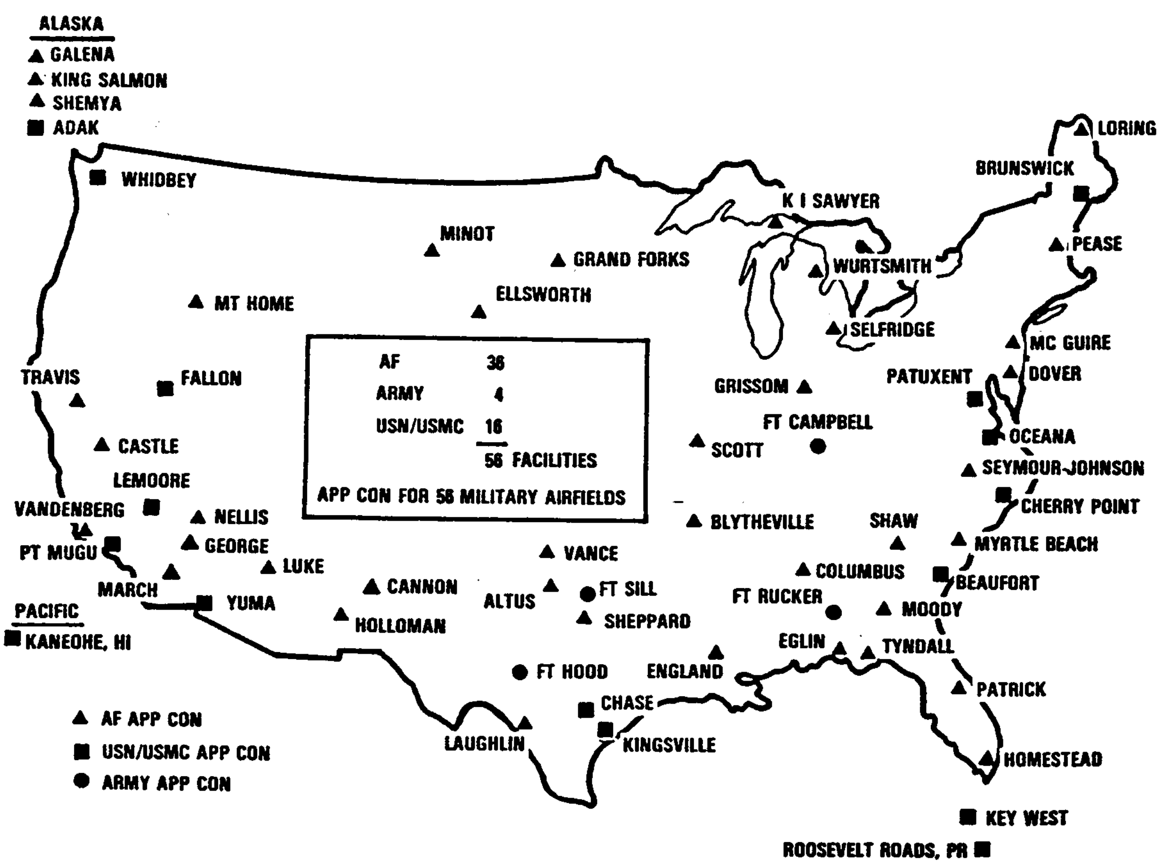


FIGURE 9-2: TODAY'S DOD RADAR APPROACH CONTROL ARCHITECTURE

- Enable effective military aircraft and weapon systems training and testing through provision of ATC services to support DOD aviation activities. The means of support include:

  - Facilities
  - Equipment
  - Personnel

- Establish, maintain, and manage SUA for research and development of new weapons and realistic DOD training with state-of-the-art weapon systems.

- Ensure sovereignty over the nation's airspace through provision of aircraft detection and recognition.

- Support missile and space launches/firings.

- Maintain interoperability and compatibility with the National Airspace System.

- Retain sufficient military ATC radar facilities to train a cadre of military controllers and maintenance personnel to meet overseas and wartime needs.

- Support the implementation of Executive Order 11161.

ASSUMPTIONS

Upon analysis of the NAS Plan, the DOD arrived at the following set of assumptions:

- The DOD will procure ATC, Ground-to-Air Communications, Interfacility Communications, and Maintenance and Operations Support systems to maintain full interoperability with those procured by the FAA, to the maximum extent practical.

- Each DOD ATC facility will be fully interoperative with its adjacent, and parent, FAA/DOD facilities. Simply stated, each of the following DOD facilities will be a full participant in the NAS.

  - Consolidated Radar Facilities (CRFs). CRFs provide services identical to those provided by FAA Area Control Facilities (ACFs), including en route and terminal services. These services are provided for the principal military base concerned and for all civil and military airfields located within their delegated airspace of authority.

  - Military Terminal Radar Approach Controls (M-TRACONs). Military TRACONs provide approach control services identical to those provided by FAA TRACONs/TRACABs. These facilities provide radar and non-radar arrival, departure, and over-flight (en route) services to aircraft within their delegated airspace.

  - Military Control Tower (MCT). MCT facilities provide services identical to those provided by FAA Air Traffic Control Towers (ATCTs), including arrival and departure sequencing, control of movements on airports, runways, and taxiways, and dissemination of airfield conditions and weather information.

  - Military Base Operations (MBO). MBOs perform functions similar to FAA Automated Flight Service Stations (AFSSs). An MBO is a facility organized, manned, and equipped to provide flight assistance services (FAS) to military aircrews including: flight planning, pilot briefing, airport condition status, search and rescue service initiation, and the origination, receipt, processing modification, and cancellation of flight plans and NOTAMs.

  - Ground Control Approach (GCA) Facility. GCAs control only the terminal traffic airspace around an airfield by providing radar vectoring, traffic advisory service, and final approach guidance to pilots. There is no FAA equivalent to the GCA facility.

  - Military Weather System (MWX) Facility. MWX consists of: atmospheric, oceanographic, and space based environmental sensors; communication networks; data processing and interactive computer systems; and support facilities and personnel. MWX provides weather data tailored to specific DOD mission requirements.

  - Fleet Area Control and Surveillance Facility (FACSFAC). FACSFAC is a unique Navy ATC facility using radar and other surveillance capabilities (e.g., Naval Tactical Data System (NTDS)) to provide ATC, air combat direction, and/or range /area surveillance, as well as the management of DOD offshore operating areas.

- When viewed from a purely air traffic control perspective, there are certain unique military ATC requirements (i.e., integrated air traffic control of visual flight rules (VFR) and instrument flight rules (IFR) aircraft entering, within, and leaving SUAs).
  - There may be some unique DOD security requirements (i.e., the need to process DOD "classified" information).
- Where appropriate, equitable cost sharing for systems procurement will be negotiated between FAA and DOD.

DEMAND ON THE SYSTEM

As more advanced aircraft, weapon systems, and tactics become available to the military, the requirement for SUA to exercise total weapon system capabilities, testing, and training becomes more urgent. Increasing commercial and general aviation activity, with its associated demand for more airspace, is a competing interest. A standardized, interoperable NAS will allow maximum civil aviation utilization of SUA when it is not in use by military aircraft.

CURRENT OPERATION

The DOD currently operates ATC facilities only where there is a military necessity.

Military ATC facilities are established at locations that meet the following criteria:

- Tactical and training operations are conducted.
- High concentrations of military traffic.
- SUA is located near military airfields.

FUTURE NEEDS

Airports: No additional requirements for DOD airports are envisioned through the year 2000.

SERVICES

- Aircraft, airspace, and terrain separation.
- Support for SUA and military training routes.
- Support for military combined air and ground operations.
- Support for unique modes and concepts of operation.
- Aeronautical information, SUA schedules, and preferred routes.
- Flow control advisories and airspace saturation information.
- Approach and departure sequencing.
- Weather avoidance.
- In-flight emergency assistance.
- Search and rescue.
- Weather advisories.
- Priority handling, coded flights.
- Navigation/landing aids and airport status (i.e., NOTAMs).

AIRBORNE UTILIZATION

- Airborne refueling.
- SR-71 flights.
- Aircraft surge launch and recovery (ASLAR).
- Cruise missiles.
- Remotely piloted vehicle (RPV) flights.
- Readiness exercises such as Solid Shield, Volant Boom, Maple Flag, Red Flag, Green Flag, Copper Flag, etc.
- Trailing wire.
- Troop and material movement.
- National Emergency Airborne Command Post (NEACP) (Nightwatch).
- Flynet.
- Test and evaluation missions.
- Aloha strike operations.

- Air wing relocations.
- Wartime and national emergency operations.
- Electronic countermeasure operations.
- Missile launch and recovery.
- Operational readiness inspections.
- Long-range helicopter IFR.
- Flights above 60,000 feet msl.

HOW THE SYSTEM WILL EVOLVE NEAR-TERM (TO 1990)

Planning for the DOD NAS has begun. A DOD ATC facility architecture for the end-state (post-1995) NAS has been determined. The architecture calls for CRFs and stand-alone TRACONs to provide approach control services to military and civil airfields. All DOD control towers will be retained. In accordance with a joint DOD/FAA MOA, DOD will transfer responsibility for 14 approach controls to FAA and assume responsibility for 5 now operated by FAA (see Figure 9-3). An FAA-commissioned study of these approach control realignments found a cost savings to the nation of $470.3 million (in constant 1988 dollars) over the NAS life cycle. Near-term activity in support of the NAS Plan will concentrate in the following areas:

- Military construction requirements analysis.
- Specification development and study.
- DOD NAS baseline life cycle cost.
- Facility/equipment functionality requirements study.
- DOD-specific requirements study and design.
- Develop NAS change proposals.
- DOD/FAA interoperability/integration plan development.

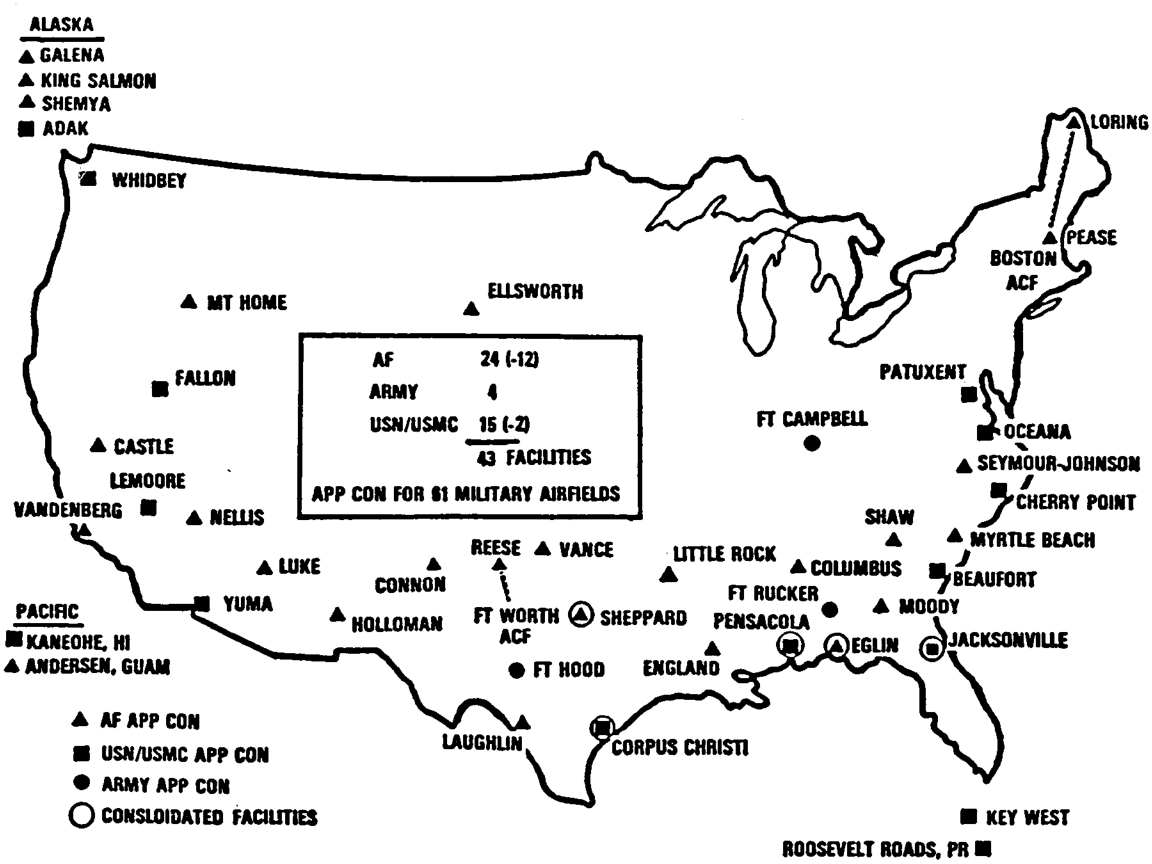


FIGURE 9-3: TOMORROW'S DOD RADAR APPROACH CONTROL ARCHITECTURE

LONG TERM (to 2000)

The DOD plans the construction of CRFs, upgrade of stand-alone TRACONs, and other NAS-related facilities where required. Upgrade of existing systems and acquisition of new hardware/software systems determined to be required and cost effective by DOD will be accomplished during this period.

Data from the studies performed in the near-term will be used for this determination. DOD transition plans will be developed and interfaced with those of FAA and where appropriate mutual support agreements negotiated. Engineering plans for all DOD facilities will be finalized. Installation of newly acquired ATC systems in DOD facilities will commence during this period.

RELATIONSHIP WITH NAS PROJECTS

The DOD must continue to efficiently operate within and as part of the NAS. This includes not only point-to-point operations, but also a smooth transition to and from SUAs/ranges, IFR and VFR training routes, and tactical deployments within the continental United States (CONUS).

The DOD's ATC facilities must operate in a way that does not impede the automated efficiencies that will be established in the new NAS. DOD aviation and DOD air traffic control can benefit from NAS modernization only if interoperability is maintained. Modernization offers the opportunity to form a cohesive national FAA and DOD NAS architecture.

The DOD will prioritize the benefits that can be derived from each NAS Plan project. These priorities will determine the extent of DOD implementation of each system. The elements used for prioritizing the NAS Plan projects for DOD implementation are:

- Improved safety of flight.
- Availability of state-of-the-art systems to economically replace aging equipment at the end of its life cycle.
- Improved reliability and maintainability.
- Interoperability with the FAA.
- Improved operational capabilities.
- Commonality among military departments and FAA.
- Cost and availability of funds.

The priorities and cost benefits will determine the extent that DOD ATC facilities will be modernized with FAA equipment. The new systems and degree of automation to be acquired by DOD will be defined at that time.

FUNCTIONAL - ORGANIZATION

ATC

The ATC function provides en route and terminal information and services needed to conduct safe and efficient flight operations. Both FAA and DOD facilities provide these ATC services. The DOD facilities involved with ATC include those that provide en route control, terminal control, range control, and transfer of flight data.

DOD ATC encompasses a greater variety of services than those provided by the FAA. DOD agencies are tasked to provide ATC services within combat zones and for air-capable ships at sea. During peacetime and in wartime, DOD operations are directed toward support of training and testing missions. The functions involved in the missions include.

- Provision for ATC services in accordance with area airspace agreements.
- Implementation of policies and procedures.
- Coordination of ATC operations between military units, other Government agencies, and foreign government units.
- Interface of DOD ATC systems and facilities with other non-DOD ATC systems and facilities.
- Employment of ATC units in support of military and civil aviation operations.

The ATC system that evolves from the DOD implementation of the NAS Plan must be totally interoperable between the military services. The DOD equipment must be adaptable for interface with foreign ATC systems.

COMMUNICATIONS

Ground-to-air communication facilities provide voice radio communications between ATC facilities and aircraft through the use of radios. While the FAA requires separate facilities for en route and terminal communications, the DOD provides communications predominantly within the terminal area. As DOD assumes more en route responsibilities in accordance with the DOD architecture, Remote Center Air/Ground (RCAG) communication stations may be required.

NAVIGATION

While the basic civil navigation aid system is the VHF Omnidirectional Range (VOR), the military's system is the Tactical Air Navigation (TACAN). The DOD also uses Nondirectional Beacons (NDB), both low frequency and UHF, as part of their landing systems. Except for TACANs on air-capable ships, these systems will be replaced by the Global Positioning System (GPS).

APPROACH AND LANDING AIDS

In this area, the DOD system differs significantly from the FAA system. While DOD uses the Instrument Landing System (ILS) for precision approach at bases supporting multi-engine aircraft, many bases still utilize Precision Approach Radar (PAR) that provides a talk-down approach for aircraft. DOD plans to replace ILS and PAR with the FAA-developed Microwave Landing System (MLS).

GLOSSARY OF ACRONYMS

ACCILS	Aeronautical Center centralized integrated logistics support
ACF	area control facility
ADAS	AWOS data acquisition system
ADDM	automated documentation development and maintenance
ADP	automated data processing
ADS	automatic dependent surveillance
ADTN	administrative data transmission network
A&E	architectural and engineering
AERA	automated en route air traffic control
AF	airway facilities
AFSS	automated flight service station
AFTN	aeronautical fixed telecommunications network
A/G	air-to-ground
agl	above ground level
AIP	airport improvement program
AIRMET	airmen's meteorological information
ALSF	approach lighting system with sequenced flashing lights
ALSIP	approach lighting system improvement program
ARINC	Aeronautical Radio, Incorporated
ARSR	air route surveillance radar
ARTCC	air route traffic control center
ARTS	automated radar terminal system
ASD	aircraft situation display
ASDE	airport surface detection equipment
ASLAR	aircraft surge launch and recovery
ASOS	automated surface observing system
ASP	arrival sequencing program
ASR	airport surveillance radar
AT	air traffic
ATC	air traffic control
ATCBI	air traffic control beacon interrogator
ATCCC	air traffic control command center
ATCRBS	air traffic control radar beacon system
ATCT	airport traffic control tower
ATIS	automatic terminal information service
ATMS	advanced traffic management system
AUTODIN	automated digital network
AUTOVON	automatic voice network

BRITE	bright radar indicator tower equipment
BUEC	backup emergency communications
CA	conflict alert
CA/MSAW	conflict alert/minimum safe altitude warning
CARF	central altitude reservation function
CBI	computer based instruction
CCC	central computer complex
CCD	consolidated cab display
CCP	contingency command post
CD	common digitizer
CDC	computer display channel
CDR	critical design review
CDT	controlled departure times
CERAP	combined center radar approach control
CFCC	central flow control computer
CFCF	central flow control function
CFDPS	compact flight data processing system
CFMWP	central flow meteorologist weather processor
CFWP	central flow weather processor
CFWSU	central flow weather service unit
CNS	consolidated NOTAM system
crt	cathode ray tube
CWP	central weather processor
CWSU	center weather service unit
CY	calendar year
DARC	direct access radar channel
dc	direct current
DCC	display channel complex
DES	data encryption standard
DF	direction finder
DLP	data link processor
DME	distance measuring equipment
DME/P	precision distance measuring equipment
DMN	data multiplexing network
DOD	Department of Defense
DOT	Department of Transportation
DSB	double sideband
DSP	departure sequencing program
DUAT	direct user access terminal
DVOR	Doppler very high frequency omnidirectional range
EARTS	en route automated radar tracking system

ERM	en route metering
ESMMC	enhanced SMMC
ESP	en route spacing program
ETG	enhanced target generator
FAA	Federal Aviation Administration
FAATC	FAA Technical Center
FACSFAC	fleet area control and surveillance facility
FAT	factory acceptance test
FDEP	flight data entry and printout
FDIO	flight data input/output
FDPS	flight data processing system
F&E	facilities and equipment
F,E&D	facilities, engineering, and development
FIFO	flight inspection field office
FIR	flight information region
FM	frequency modulation
FPS	military primary radar
FSAS	flight service automation system
FSDPS	flight service data processing system
FSP	flight strip printer
GMCC	general NAS maintenance control center
GNAS	general NAS
GOES	geostationary operational environmental satellite
GPO/GPI	general purpose output/general purpose input
GPS	global positioning system
GSA	General Services Administration
GSL	general support laboratory
GWDS	graphic weather display system
H	homing radio beacon
HEMP	high altitude electromagnetic pulse
HF	high frequency
HIWAS	hazardous in-flight weather advisory service
HRM	human resource management
HUD	head-up display
HVAC	heating, ventilating, and air conditioning
ICAO	International Civil Aviation Organization
ICSS	integrated communications switching system
IFCN	interfacility flow control network

IOP	input/output processor
IRBT	integrated radar beacon tracker
ISSS	initial sector suite system
ITU	International Telecommunications Union
IVRS	interim voice response system
JAWS	joint airport weather studies
JSS	joint surveillance system
KDP	key decision point
kHz	kilohertz
kW	kilowatt
kWh	kilowatt hour
LCN	local communications network
LIS	logistics inventory system
LLWAS	low level wind shear alert system
LORAN	long range navigation
LRR	long range radar
LRU	line replaceable unit
M1FC	model 1 full capacity
MALSR	medium-intensity approach lighting system with runway alignment indicator lights
MAR	minimally attended radar
MCT	military control tower
MDARC	mosaic tracking direct access radar channel
MDT	maintenance data terminal
MED	manual entry device
MHz	megahertz
MLS	microwave landing system
MMS	maintenance management system
MOA	memorandum of agreement
Mode C	altitude reporting mode of secondary radar
Mode S	discrete addressable secondary radar system with data link
modem	modulator-demodulator
MOS	metal-oxide semiconductor
MPS	maintenance processor subsystem
MSAW	minimum safe altitude warning
msl	mean sea level
MSN	message switched network
MTBF	mean time between failures
M-TRACON	military terminal radar approach control
MWP	meteorologist weather processor
MWX	military weather system

TDWR	terminal Doppler weather radar
T&E	test and evaluation
TERPS	terminal instrument procedures
T-LABS	terminal Los Angeles basin service
TML	television microwave link
TMP	traffic management processor
TMS	traffic management system
TMU	traffic management unit
TPX	military beacon system
TRACAB	terminal radar approach control in the tower cab
TRACON	terminal radar approach control
TSC	Transportation System Center
TSSC	technical support services contract
TSSF	terminal system support facility
VFR	visual flight rules
VFSS	voice frequency signaling system
VHF	very high frequency
VLF	very low frequency
VOR	VHF omnidirectional range
VORTAC	VOR co-located with TACAN
VOT	VHF omnidirectional range test
VRS	voice response system
VSCS	voice switching and control system
VTOL	vertical take off and landing
WMSC	weather message switching center
WSR	weather service radar
Wx	weather
9020	computer system model number

NAS	national airspace system
NASA	National Aeronautics and Space Administration
NASMAP	NAS management automation program
NASNET	national airspace system network
NASP	national airport system plan
NATCOM	National Communications Center, Kansas City, Missouri
navaid	navigational aid
NAWP	national aviation weather processor
NCC	network control center
NCIU	NEXRAD communications interface unit
NDB	nondirectional beacon
NEACP	national emergency airborne command post
NEOF	national emergency operations facilities
NEXRAD	next generation weather radar
NICS	NAS interfacility communications system
NMCE	network management and control equipment
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
NWSTG	NWS telecommunications gateway
OATS	office of automation technology and services
OCAT	Oklahoma City airport trust
ODALS	omnidirectional approach lighting system
ODAPS	oceanic display and planning system
OFDPS	offshore flight data processing system
OMB	Office of Management and Budget
ORD	operational readiness demonstration
OSHA	Occupational Safety and Health Administration
OTA	Office of Technology Assessment
OT&E	operational test and evaluation
PAMRI	peripheral adapter module replacement item
PAPI	precision approach path indicator
PAR	precision approach radar
PATWAS	pilots automatic telephone weather answering service
PCRM	parallel and converging runway monitor
PCS	power conditioning system

PUP	principal user processor
PVD	plan view display
RADS	radar alphanumeric display system
RAPCON	radar approach control
RCAG	remote center air/ground communications facility
RCE	radio control equipment
RCF	remote communications facility
RCIU	remote control interface unit
RCL	radio communications link
RCO	remote communications outlet
R&D	research and development
R, E&D	research, engineering and development
REIL	runway-end identification lights
RF	radio frequency
RFI	radio frequency interference
RFP	request for proposal
RML	radar microwave link
RMM	remote maintenance monitoring
RMMS	remote maintenance monitoring system
RMS	remote monitoring subsystem
RMSC	RMS concentrators
RNAV	area navigation
RVV	runway visibility value
RWP	real-time weather processor
SAR	system analysis recorder
SEI	system engineering and integration
SET	system embedded training
SIAP	standard instrument approach procedure
SIGMET	significant meteorological information
SMMC	system maintenance monitor console
SSALF	simplified short approach lighting system with sequenced flashing lights
SSALR	simplified short approach lighting system with runway alignment indicator lights
SSB	single sideband
SSF	system support facility
SSL	system support laboratory
SSR	secondary surveillance radar
STAR	Southern California terminal airspace realignment
STEP	service test and evaluation program
STOL	short take off and landing
SUA	special use airspace
TAA	terminal advanced automation

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